Astrodyne
Now you have power.

DC/DC and AC/DC Converter Modules

Catalog and Applications Handbook

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CONTENTS

RO

Astrodyne

Now you have power.

Astrodyne Corporation designs, manufactures and solves power conversion challenges world-wide by offering a broad assortment of AC/DC switching power supplies, AC/DC adapters, DC/AC inverters and DC/DC converters. With more than 4,000 cost-effective standard and modified power supplies, Astrodyne is continuously expanding its offerings to meet new industry standards and application requirements.

Included in Astrodyne's extensive DC/DC converter offerings is the RO product line of ruggedized high-efficiency and high reliability DC/DC converters which incorporate an Insulated Metal Substrate construction, full component encapsulation and a fixed frequency design providing exceptional thermal and shock and vibration characteristics with manageable EMI performance. With DC/DC power levels from 40-700W and AC/DC PFC converters with power levels from 375-1000W available in a variety of brick design styles and a family of accessories which assist in the design and implementation of a distributed power architecture, Astrodyne's RO products are ideal for use in COTS, industrial and other harsh-environment applications. In addition, as with many of its other product families, Astrodyne's RO product line offers the ability to customize or modify its power supplies to fit your specific requirements.

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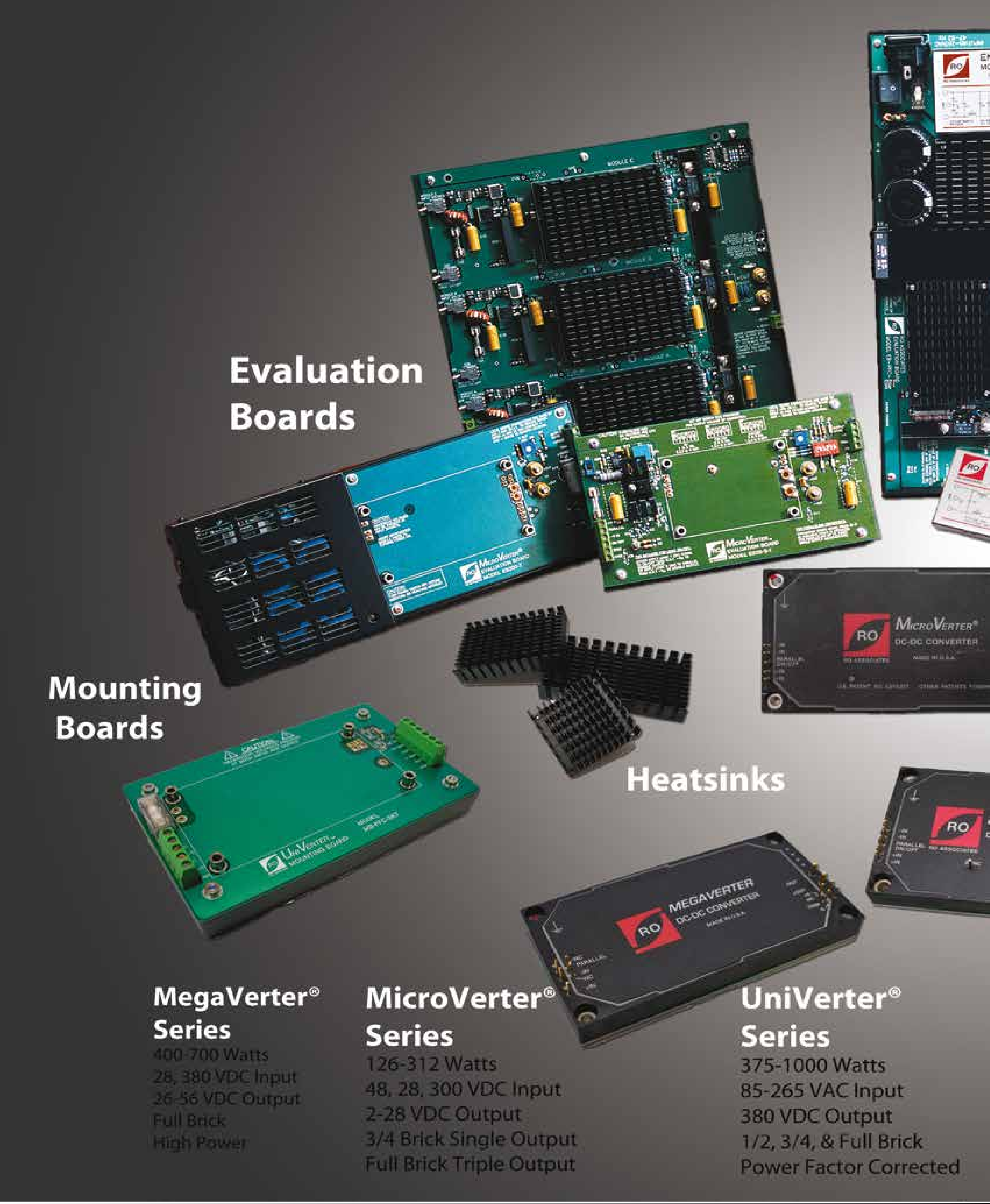
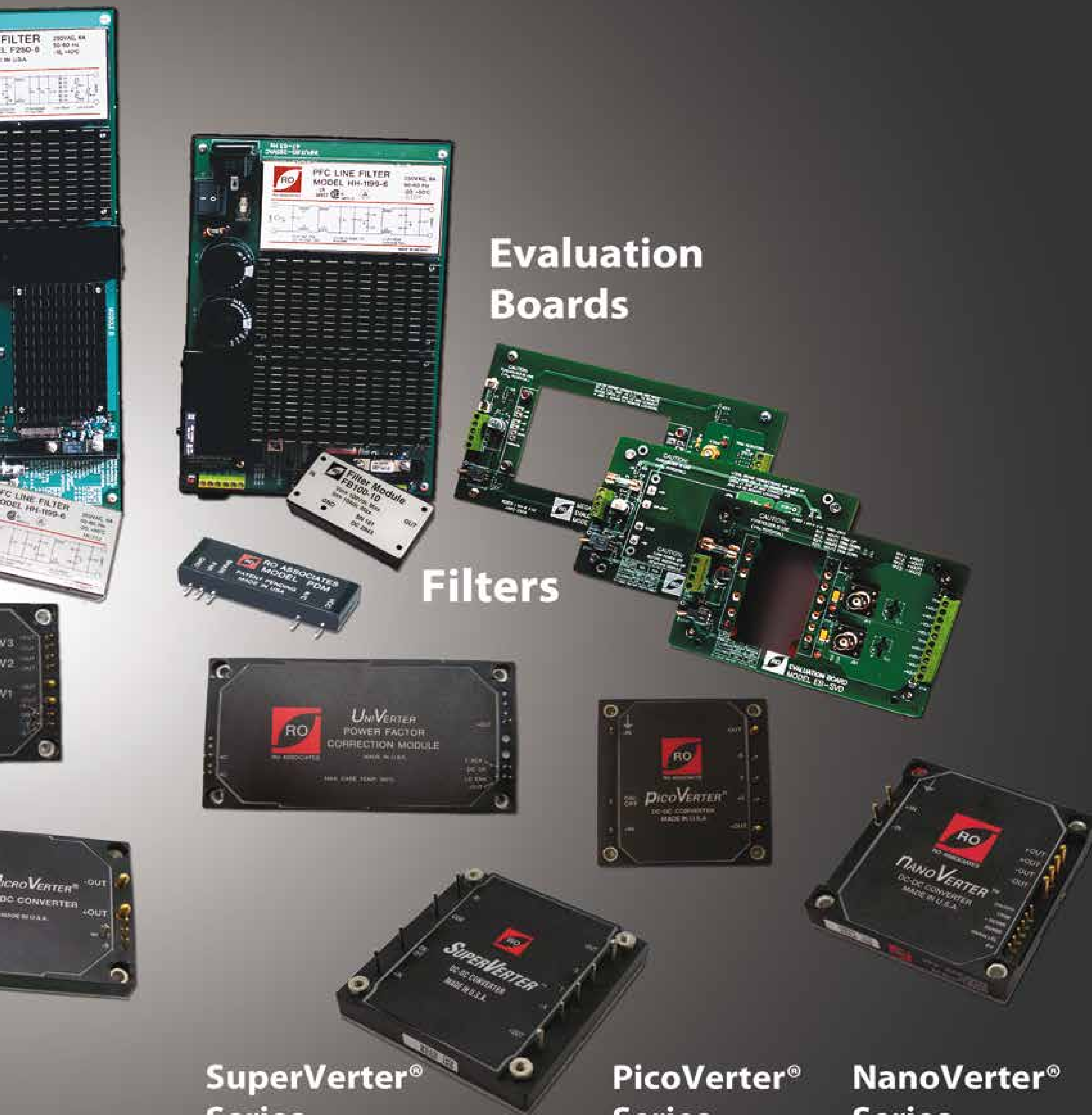

Evaluation Boards
Mounting Boards
Heatsinks
MegaVerter® Series
400-700 Watts
28, 380 VDC Input
26-56 VDC Output
Full Brick
High Power
MicroVerter® Series
126-312 Watts
48, 28, 300 VDC Input
2-28 VDC Output
3/4 Brick Single Output
Full Brick Triple Output
UniVerter® Series
375-1000 Watts
85-265 VAC Input
380 VDC Output
1/2, 3/4, & Full Brick
Power Factor Corrected



Evaluation Boards

Filters

SuperVerter® Series

75-240 Watts
48, 24 VDC Input
1.8-28 VDC Output
1/2 Brick
Industry Standard

PicoVerter® Series

40-60 Watts
300 VDC Input
3.3-24 VDC Output
1/2 Brick

NanoVerter® Series

63-120 Watts
300 VDC Input
2.1-24 VDC Output
1/2 Brick

CONVERTER SELECTION GUIDE

Model Number	Input Voltage	Output Voltage (Volts)	Output Current (Amps)	Output Power (Watts)	Page #
AC-DC WITH PFC 650-1000 WATT FAMILY					
4.6 x 2.4 x 0.5" Full-Brick					
SMV-28-500	85-265VAC	28V	18A	500W	8
SMV-48-500	85-265VAC	48V	10.5A	500W	8
SMV-12-500	85-265VAC	12V	42A	500W	15
3.6 x 2.4 x 0.5" Three-Quarter Brick					
PFC-650	85-265VAC	375V	1.75A	650W	115
2.3 x 2.4 x 0.5" Half-Brick					
PFC-375	85-265VAC	375V	1.0A	375W	108
1.45 x 2.28 x 0.5 Quarter-Brick					
PFC-180	85-265VAC	375V	0.48A	180W	*
4.6 x 2.4 x 0.5" Full-Brick					
PFC-600	85-265VAC	380V	1.6A	600W	122
PFC-1000	170-265VAC	380V	2.6A	1000W	122
DC-DC SINGLE OUTPUT 50-60 WATT FAMILY					
2.3 x 2.4 x 0.42" Half-Brick					
PV300-3	300VDC	3.3V	45A	40W	106
PV300-5	300VDC	5V	10A	50W	106
PV300-12	300VDC	12V	5A	60W	106
PV300-15	300VDC	15V	4A	60W	106
PV300-24	300VDC	24V	2.5A	60W	106
DC-DC SINGLE OUTPUT 75 WATT FAMILY					
1.45 x 2.28 x 0.5 Quarter-Brick					
ASD75-24S3.3Q	24VDC	3.3V	20A	66W	167
ASD75-24S5Q	24VDC	5V	15A	75W	167
ASD75-24S12Q	24VDC	12V	6.5A	78W	167
ASD75-24S15Q	24VDC	15V	5.0A	75W	167
ASD75-24S24Q	24VDC	24V	3.13A	75W	167
ASD75-48S3.3Q	48VDC	3.3V	20A	66W	167
ASD75-48S5Q	48VDC	5V	15A	75W	167
ASD75-48S12Q	48VDC	12V	6.5A	78W	167
ASD75-48S15Q	48VDC	15V	5.0A	75W	167
ASD75-48S24Q	48VDC	24V	3.13A	75W	167
DC-DC SINGLE OUTPUT WIDE INPUT 80-100 WATT FAMILY					
2.3 x 2.4 x 0.5 Half-Brick					
ASD100-24S3.3W	9-36VDC	3.3V	25A	80W	45
ASD100-24S5W	9-36VDC	5V	20A	100W	45
ASD100-24S12W	9-36VDC	12V	8.33A	100W	45
ASD100-24S15W	9-36VDC	15V	6.67A	100W	45
ASD100-24S24W	9-36VDC	24V	4.13A	100W	45
ASD100-48S3.3W	18-75VDC	3.3V	25A	80W	45
ASD100-48S5W	18-75VDC	5V	20A	100W	45
ASD100-48S12W	18-75VDC	12V	8.33A	100W	45
ASD100-48S15W	18-75VDC	15V	6.67A	100W	45
ASD100-48S24W	18-75VDC	24V	4.13A	100W	45
DC-DC SINGLE OUTPUT 100-120 WATT FAMILY					
2.3 x 2.4 x 0.42" Half-Brick					
nV300-3	300VDC	3.3V	25A	82.5W	104
nV300-5	300VDC	5V	20A	100W	104
nV300-12	300VDC	12V	10A	120W	104
nV300-15	300VDC	15V	8A	120W	104
nV300-24	300VDC	24V	5A	120W	104
DC-DC SINGLE OUTPUT 150 WATT FAMILY					
1.45 x 2.28 x 0.5 Quarter-Brick					
ASD150-24S3.3QB	24VDC	3.3V	45A	150W	171
ASD150-24S5QB	24VDC	5V	30A	150W	171
ASD150-24S12QB	24VDC	12V	12.5A	150W	171
ASD150-48S3.3QB	48VDC	3.3V	45A	150W	171
ASD150-48S5QB	48VDC	5V	30A	150W	171
ASD150-48S12QB	48VDC	12V	12.5A	150W	171
SINGLE OUTPUT WIDE INPUT 100-150 WATT FAMILY					
2.3 x 2.4 x 0.5 Half-Brick					
ASD150-24S3.3W	9-36VDC	3.3V	30A	100W	49
ASD150-24S5W	9-36VDC	5V	30A	150W	49
ASD150-24S12W	9-36VDC	12V	12.5A	150W	49
ASD150-24S15W	9-36VDC	15V	10A	150W	49
ASD150-24S24W	9-36VDC	24V	6.26A	150W	49
ASD150-48S3.3W	18-75VDC	3.3V	30A	100W	49
ASD150-48S5W	18-75VDC	5V	30A	150W	49
ASD150-48S12W	18-75VDC	12V	12.5A	150W	49
ASD150-48S15W	18-75VDC	15V	10A	150W	49
ASD150-48S24W	18-75VDC	24V	6.26A	150W	49
SINGLE OUTPUT WIDE INPUT 240 WATT FAMILY					
2.3 x 2.4 x 0.5 Half-Brick					
ASD240-24S12W	9-36VDC	12V	20A	240W	53
ASD240-24S15W	9-36VDC	15V	16A	240W	53
ASD240-24S24W	9-36VDC	24V	10A	240W	53
ASD240-24S28W	9-36VDC	28V	8.6A	240W	53
ASD240-24S48W	9-36VDC	48V	5A	240W	53

Model Number	Input Voltage	Output Voltage (Volts)	Output Current (Amps)	Output Power (Watts)	Page #
DC-DC SINGLE OUTPUT	**150-200 WATT FAMILY**				
42.3 x 2.4 x 0.5 Half-Brick					
SV28-3.3-150-1	24VDC	3.3V	30A	100W	43
SV28-3.3-200-1	24VDC	3.3V	40A	132W	43
SV28-5-150-1	24VDC	5V	30A	150W	43
SV28-5-175-1	24VDC	5V	35A	175W	43
SV28-5-200-1	24VDC	5V	40A	200W	43
SV28-12-150-1	24VDC	12V	12.5A	150W	43
SV28-12-200-1	24VDC	12V	20.0A	200W	43
SV28-24-150-1	24VDC	24V	6.3A	150W	43
SV28-24-200-1	24VDC	24V	10A	200W	43
SV28-28-150-1	24VDC	28V	5.35A	150W	43
SV28-28-200-1	24VDC	28V	8.60A	200W	43
DC-DC SINGLE OUTPUT	**250-350 WATT FAMILY**				
3.6 x 2.4 x 0.5" Three-Quarter Brick					
µV24-5-164	24VDC	5.0V	20A	250W	*
µV24-8-164	24VDC	8.0V	36A	288W	*
µV24-12-164	24VDC	12V	25A	300W	27
µV24-15-164	24VDC	15V	20A	300W	31
µV24-24-164	24VDC	24V	12.5A	312W	35
µV24-28-164	24VDC	28V	11A	308W	39
µV48-8-164	48VDC	8.0V	20A	250W	179
µV48-12-164	48VDC	12V	25A	300W	183
µV300-5-164	300VDC	5.0V	20A	250W	74
µV300-8-164	300VDC	8V	36A	288W	79
µV300-12-164	300VDC	12V	25A	300W	84
µV300-15-164	300VDC	15V	20A	300W	89
µV300-24-164	300VDC	24V	12.5A	312W	94
µV300-28-164	300VDC	28V	11A	308W	99
DC-DC SINGLE OUTPUT	**300-400 WATT FAMILY**				
2.3 x 2.4 x 0.5 Half-Bric					
SV24-12-300-1	24VDC	12V	25A	300W	58
SV24-24-300-1	24VDC	24V	12.5A	300W	58
SV24-28-350-1	24VDC	28V	12.5A	350W	58
SV24-32-400-1	24VDC	32V	12.5A	400W	58

Model Number	Input Voltage	Output Voltage (Volts)	Output Current (Amps)	Output Power (Watts)	Page #
DC-DC SINGLE OUTPUT	**200-250 WATT FAMILY**				
3.6 x 2.4 x 0.5" Three-Quarter Brick					
µV28-3	28VDC	3.3V	50A	165W	25
µV28-5	28VDC	5V	40A	200W	25
µV28-8	28VDC	8V	30A	240W	25
µV28-12	28VDC	12V	20A	240W	25
µV28-15	28VDC	15V	16A	240W	25
µV28-24	28VDC	24V	10A	240W	25
µV28-28	28VDC	28V	9A	252W	25
µV48-8	48VDC	8V	30A	240W	*
µV48-12	48VDC	12V	20A	240W	*
µV300-3	300VDC	3.3V	50A	165W	72
µV300-5	300VDC	5V	40A	200W	72
µV300-8	300VDC	8V	30A	240W	72
µV300-12	300VDC	12V	20A	240W	72
µV300-15	300VDC	15V	16A	240W	72
µV300-24	300VDC	24V	10A	240W	72
µV300-28	300VDC	28V	9A	252W	72
DC-DC TRIPLE OUTPUT	**185 WATT FAMILY**				
4.6 x 2.4 x 0.5" Full-Brick					
µV28-T512	28VDC	5,+12,-12V	35,3,3A	185W	25
µV28-T515	28VDC	5,+15,-15V	35,3,3A	185W	25
µV300-T512	300VDC	5,+12,-12V	35,3,3A	185W	72
µV300-T515	300VDC	5,+15,-15V	35,3,3A	185W	72
DC-DC SINGLE OUTPUT	**400-700 WATT FAMILY**				
4.6 x 2.4 x 0.5" Full-Brick					
MV380-26	380VDC	26	20A	520W	59
MV24-28-600	24VDC	28V	21.5A	600W	61
MV380-28-700	380VDC	28	25A	700W	59
MV48-28-700	48VDC	28V	25A	700W	66
AC/DC DC/DC EMI Filter Modules					
HH-1199-6	AC input	CISPR	250Vac	6A	126
FA250-5	AC input	MIL461/DO-160	250Vac	5A	127
FA250-6	AC input	MIL461/DO-160	250Vac	6A	128
FB100-10	DC input	CISPR	100Vdc	10A	129
FB50-15	DC input	MIL461/DO-160	50Vdc	15A	133
FB50-20	DC input	MIL461/DO-160	50Vdc	20A	134

Astrodyne RO
Now you have power.

500 Watt, High Efficiency, AC/DC Power Modules

SMV-500

- Miniature 4.59” x 2.4” x 0.5.” Size
- High Power Density up to 90.78W/ Inch ³
- High Efficiency up to 90% at 230VAC (48V)
- Low Output Noise
- Metal Baseplate
- Thermal Protection
- Over Voltage Protection
- Current Limit/Short Circuit Protection
- Adjustable Output Voltage 60-120% of Vo, Set
- Remote Sense
- Power On Signal (ENA) Open Collector (10mA sink current). Low (ON) when output is present

DESCRIPTION:
AC-DC Converter SMV-xx-500 modules are high power density and high efficiency AC-DC converters designed for uses in telecom and other centralized modular and distributed power applications. All use metal baseplates, planar transformers, and surface mount construction to produce up to 500W maximum.

Model Number	Output Voltage	Output Amps	Input Range	Max. Iin FL	Efficiency (Tb=25°C)	O/P Set Point
SMV-28-500	28 VDC	18	85-265 VAC	6.2A	88.5% @ 230Vin	27.44-28.56VDC
SMV-48-500	48 VDC	10.5	85-265 VAC	6.2A	90% @ 230Vin	47.04-48.96VDC

All specifications are typical at nominal input, full load, and 25DegC unless otherwise noted

BAUART GEPRÜFT TÜV Rheinland TYPE APPROVED

CE

UL® US

ABSOLUTE MAXIMUM RATINGS (MIN TO MAX.)

Input Power with No Damage	300 VAC
Power Factor Correction	0.95 min HL-LL and Full Load
Storage Temperature / Humidity	-55 to +125°C / 10 to 95%
Operating Temperature (Note 5)	-40 to 100°C
Operating Humidity	20 to 95%
Output Power	500 Watts

INPUT SPECIFICATIONS

Input Voltage (AC(L) to AC(N)	85-265 VAC
Input Frequency	47-63 Hz
Input Current FL @ 100 Vin, FL	6.2A max.
Inrush Current (Note 3)	40A @ 265VAC

OUTPUT SPECIFICATIONS

Output Voltage & Current	See Model Selection Chart PG. 1
Output Set Point	See Model Selection Chart PG. 1
Output Voltage Adjustment Range	28 Vout:16.8-33.6VDC @ FL
	48 Vout:28.8-57.6VDC @ FL
Line & Load Regulation (NL-FL)	28V: 56mV typ. / 48V: 96mV typ.
Ripple/Noise p-p max. (Note 1)	28 Vout: 280mV
	48 Vout: 480mV
Dynamic Response (Note 6)	25% - 50% - 75% Load
Peak Deviation:	3% Vo, set
Settling Time	300uS
Current Limit (Note 2)	105-140% of Rated Load
Over Voltage Protection	125-145% Vo, set, Io=0.5A,
	Inverter Shutdown Method
Over Temperature Protection	Shutdown: 110°C typ.
	Auto Recovery: 90°C min.
Efficiency (Tb=25°C, FL)	
28 Vout:	86.5% @ 110 Vin, 88.5% @ 230Vin
48 Vout:	88% @ 110 Vin, 90% @ 230Vin, FL
	See Figs. 4a & b
	EFFICIENCY CURVES

STRUCTURAL DYNAMICS

Vibration	(Note 4)
Shock	196.1mS²

ISOLATION SPECIFICATIONS

Input-Output	3000VAC, 60S
Input-Case	2500VAC, 60S
Output-Case	1500VDC, 60S
Input-Output Capacitance	2000pF
Isolation Resistance	100MΩ @ Tb=25°C & 70%RH
	Output to Baseplate-500VDC

GENERAL SPECIFICATIONS

MTBF (Tb=40°C, 80%L, 230 Vin)	28V: 1.47 Mhrs, 48V: 1.59 Mhrs
Weight	7.05 oz (200g)
Dimensions	4.59” x 0.5” x 2.4”
	(116.8 x 12.7 x 61mm)
Safety Approvals	UL: UL 60950-1-07, 2nd Edition
	TUV: EN 60950-1:2006
	CE: EN 60950-1:2006

CONTROL SPECIFICATIONS

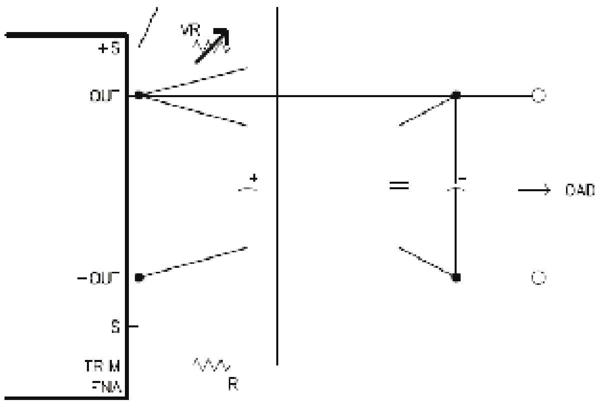
Turn-on Time	3S max., 90% Vo, set, FL
Trim Adjustment Range	60-120% w Cap. 940uF/35V (28V);
	440uF/100V (48V)
	Tb=25°C See Fig. 1 **TRIM CiRCUIT**

NOTES

1.Bandwidth 5Hz to 20MHz and with filter 4.7nF MLCC series 50Ω (28V) 100Ω (48V) min. Output Capacitor: 470uF*2, TC≥ -20°C, 470uF*4, TC≤ -20°C (28V); 220uF*2, TC≥ -20°C, 220uF*4, TC≤ -20°C (48V)
2. Current Limit inception point Vo=90% of Vo, set @ Tb-25°C; Auto recovery.
3. Turn on @ 265Vin, External Components are needed for operation Refer to Fig. 3 for application circuit.
4. Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm Constant (Max. 0.5g) X, Y. Z 1 Hour each, at No Operating
5. Temperature measurement shall be taken from the baseplate (Tb). See Fig. 2 for location definition .
6. 0.1A/uS; with cap 940uF/35V (28V); 440uF/100V (48V) Tb=25°C, Vin=200VAC

TRIM CIRCUIT:

Output Voltage Adjusted by using external resistor and/or variable resistor:

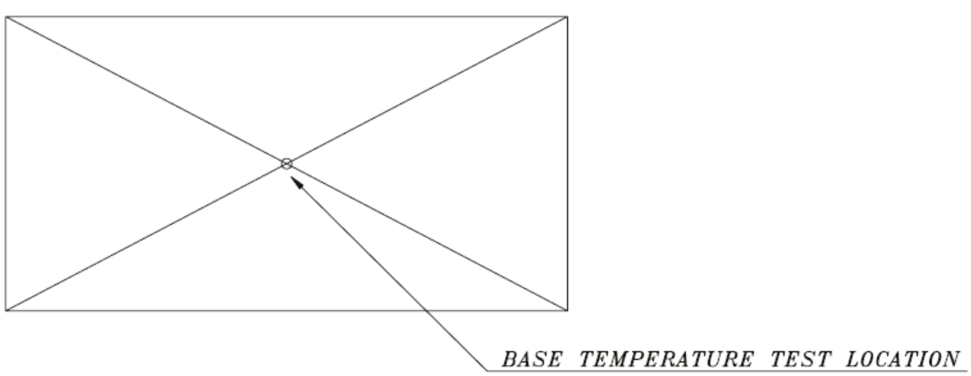


For 28Vout, R=35.7Kohm $$VR = 2.709\left(\frac{Vo_{trim}}{2.469} - 1\right) - 15.692 \quad (UNIT: K\Omega)$$

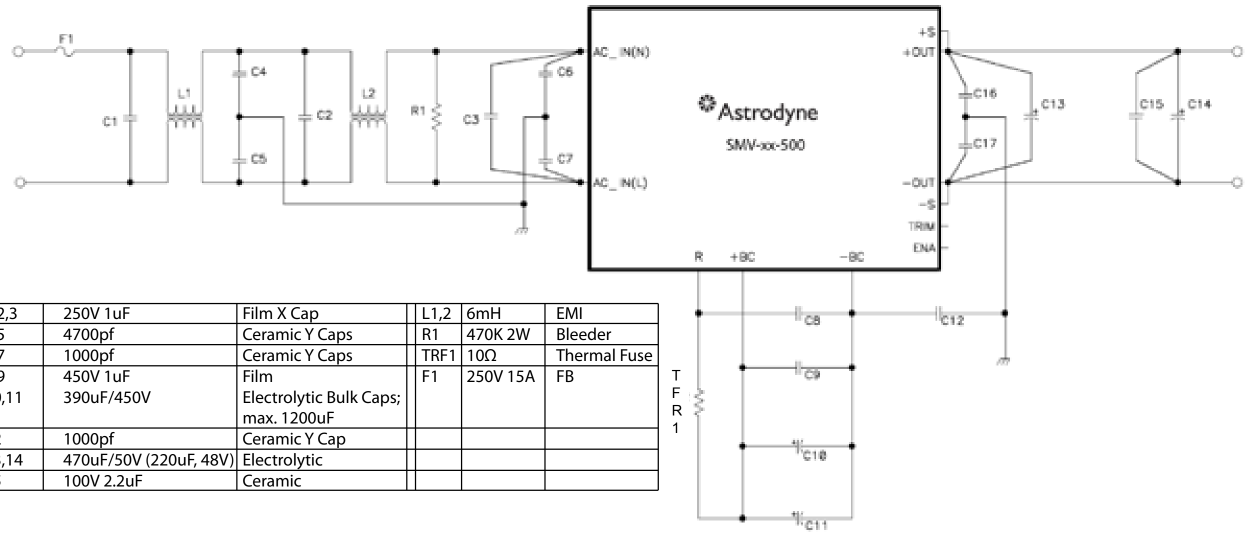
For 48Vout, R=42.2Kohm $$VR = \left(\frac{Vo_{trim}}{1.472}\right) - 19.532 \quad (UNIT: K\Omega)$$

Fig1 The schematic of output voltage adjusted by using external resistor and/or variable resistor.

BASEPLATE MEASURE POINT:



APPLICATION CIRCUIT:



C1,2,3	250V 1uF	Film X Cap	L1,2	6mH	EMI
C4,5	4700pf	Ceramic Y Caps	R1	470K 2W	Bleeder
C6,7	1000pf	Ceramic Y Caps	TRF1	10Ω	Thermal Fuse
C8,9 C10,11	450V 1uF 390uF/450V	Film Electrolytic Bulk Caps; max. 1200uF	F1	250V 15A	FB
C12	1000pf	Ceramic Y Cap			
C13,14	470uF/50V (220uF, 48V)	Electrolytic			
C15	100V 2.2uF	Ceramic			

Fig. 3 Application Circuit.

F1: This power module has no internal fuse. Use an external fuse to acquire each Safety Standard and to further improve safety. Further, Fast-Blow tyoe fuses must be used per one module. Also, In-rush Surge current flows during line throw in. Be sure to check I^2t rating of external switch and external fuse.
Recommended External Fuse: 15A
Select fuse based on rated voltage, rated current and surge capability.

1. Voltage Ratings:
   100VAC Line: AC125V
   200VAC Line: AC250V
2. Current Ratings:
   Rated current is determined by the maximum input current based on operating conditions and can be calculated using the following formula:

$$\text{Iin (max.)} = \frac{\text{Pout}}{\text{Vin x Eff x PF}} \text{ (Arms)}$$

Iin (max.): Maximum Input Current
Pout: Maximum Output Power
Vin: Minimum Input Voltage
Eff: Efficieny
PF: Power Factor

C1,2,3: 1uF (Safety Approved "X" Film Capacitor): Ripple current flows through this capacitor. When selecting capacitor, be sure to check the allowable maximum ripple current rating. Verify the actual ripple current flowing through this capacitor by doing actual measurement.
Recommended Voltage Rating: 250VAC Note: Connect C3 as near as possible to the input terminals of the power module.

C4,5: 4,700pF (Ceramic "Y" Capacitor): Add ceramic capacitor as an EMI/EMS counter measure. Be sure to consider leakage current of your equipment when adding this capacitor. High withstand voltages are applied across this capacitor depending on the application. Select capacitos with high withstand voltage ratings.

C6,7: 1,000pF (Ceramic "Y" Capacitor): Add ceramic capacitor as an EMI/EMS counter measure. Be sure to consider leakage current of your equipment when adding this capacitor. High withstand voltages are applied across this capacitor depending on the application. Select capacitos with high withstand voltage ratings.

C8,9: 1uF (Film Capacitor): Ripple current flows through this capacitor. When selecting capacitor, be sure to check the allowable maximum ripple current rating. Verify the actual ripple current flowing through this capacitor by doing actual measurement.
Recommended Voltage Rating: 450VAC Note: Select capacitor with more than 3A (rms) rating. Connect C8,9 as near as possible to the input terminals of the power module.

C10,11 (390uF x 2 PCs in parallel; Electrolytic Bulk Capacitors) Boost voltage bulk capacitor is determined by boost voltage ripple voltage, ripple current and hold-up time. Select capacitor value such that boost voltage ripple voltage does not exceed 15Vp-p.
Recommended Voltage Rating: 450VDC
Recommended Total Capacitor: 390uF to 1,200uF
Notes: 1) When ambient temperature is -20ºC or less, AC ripple of boost voltage, output ripple voltage and start-up characteristics might increase or be affected due to ESR characteristics of the bulk capacitors. Therefore, verify above characteristics by actual evaluation.
2) Do not connect apacitors with more than the above capacitance value as this would result in power module damage.

C12: 1,000pF (Ceramic "Y" Capacitor): Part of EMI filter. Choose safety approved "Y" capacitor.

C13,14: 470uF/50V (220uF for 48V Output; Electrolytic Capacitor): Take note of the maximum allowable ripple current of the electrolytic capacitor used. Especially for sudden load current changes, verify actual ripple current and make sure that allowable maximum ripple current is not to be exceeded.

C15: 2.2uF/100V (Ceramic Capacitor): Connect chip ceramic capacitor within 50mm from the output terminals +V and -V of the power module to reduce output spike noise. Also, note that output spike voltage may vary depending on the wiring pattern of the printed circuit board.

L1,2: 6mH: Add common mode choke coil as EMI/EMS counter measure. When using multiple modules, connect coil to each module. Note: Depending on the input filter used, noise might increase or power module might malfunction due to filter resonance.

R1: 470KΩ (Bleeder Resistor): Connect bleeder resistor across ACL and ACN terminals.

TFR1: 10 to 100Ω: By connecting a thermal fuse resistor across R and +BC terminals as shown in fig. 3, in-rush current during line throw-in can be suppressed. Failures due to in-rush current such as melting of external fuse, welding of relay or switch connecting joints or shutdown of No0Fuse Breakers (NFB) can occur. Therefore, be sure to connect this external thermal fuse resistor. Note: This module will not operate without this external resistor.

Selection Method of External Resistor:
1) Calculating Resistance Value for TFR1: Resistance can be calculated by the following formula:

$$R = \frac{Vin}{Irush} \ (\Omega)$$

R: Resistance Value for External TFR1
Vin: Input Voltage converted to DC value
= Input Voltage (rms) x $\sqrt{2}$
Irush: Input surge current value

2) Required Surge Current Rating: Sufficient surge current withstand capability is required for external TFR1. Required Surge Current Rating can be selected by I^2t. (Current squared multiplied by time)

$$I^2t = \frac{Co \times Vin^2}{2 \times R} (A^2s)$$

I^2t: Current squared multiplied by time
Co: Booster Voltage Bulk Capacitance
Vin: Input Voltage converted to DC value
= Input Voltage (rms) x $\sqrt{2}$
R: Resistance alue for External TFR1

EFFICIENCY CURVE: (28V):

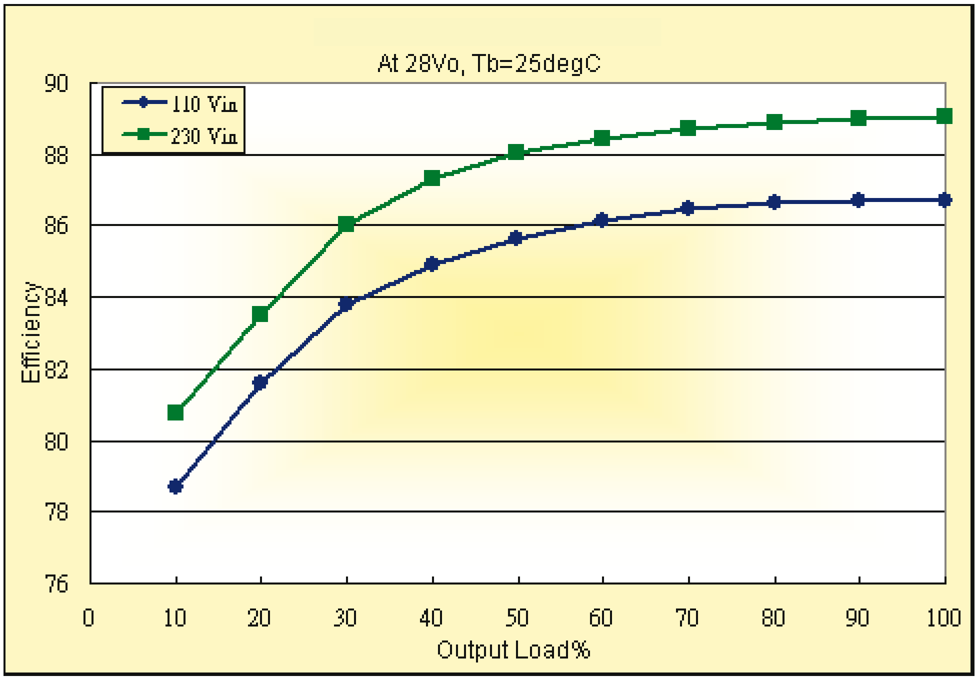


Fig. 4a Efficiency curve

EFFICIENCY CURVE: (48V):

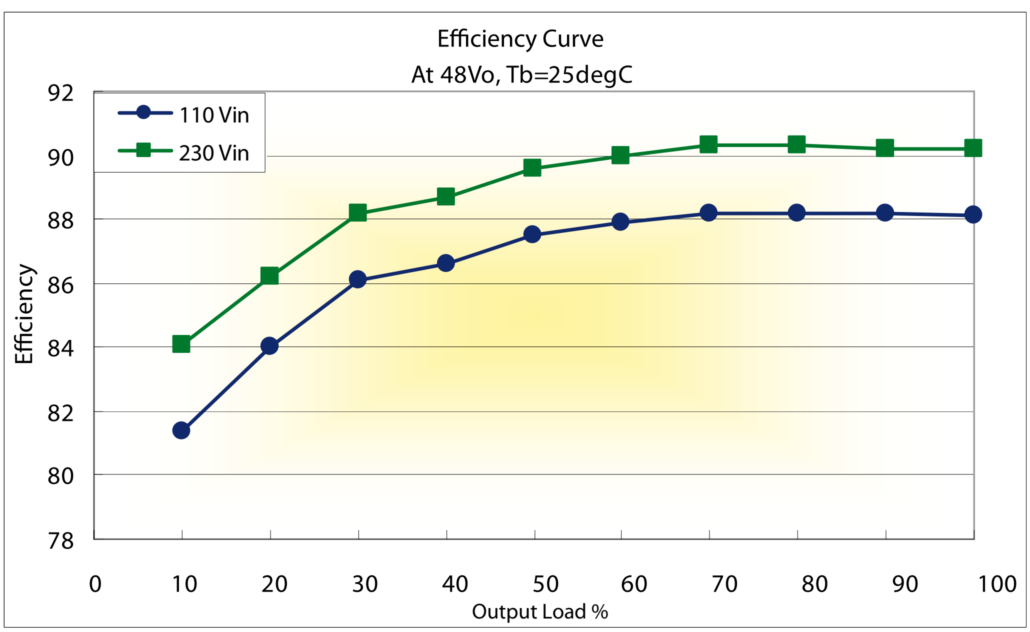


Fig. 4b Efficiency curve

MECHANICAL DIMENSIONS

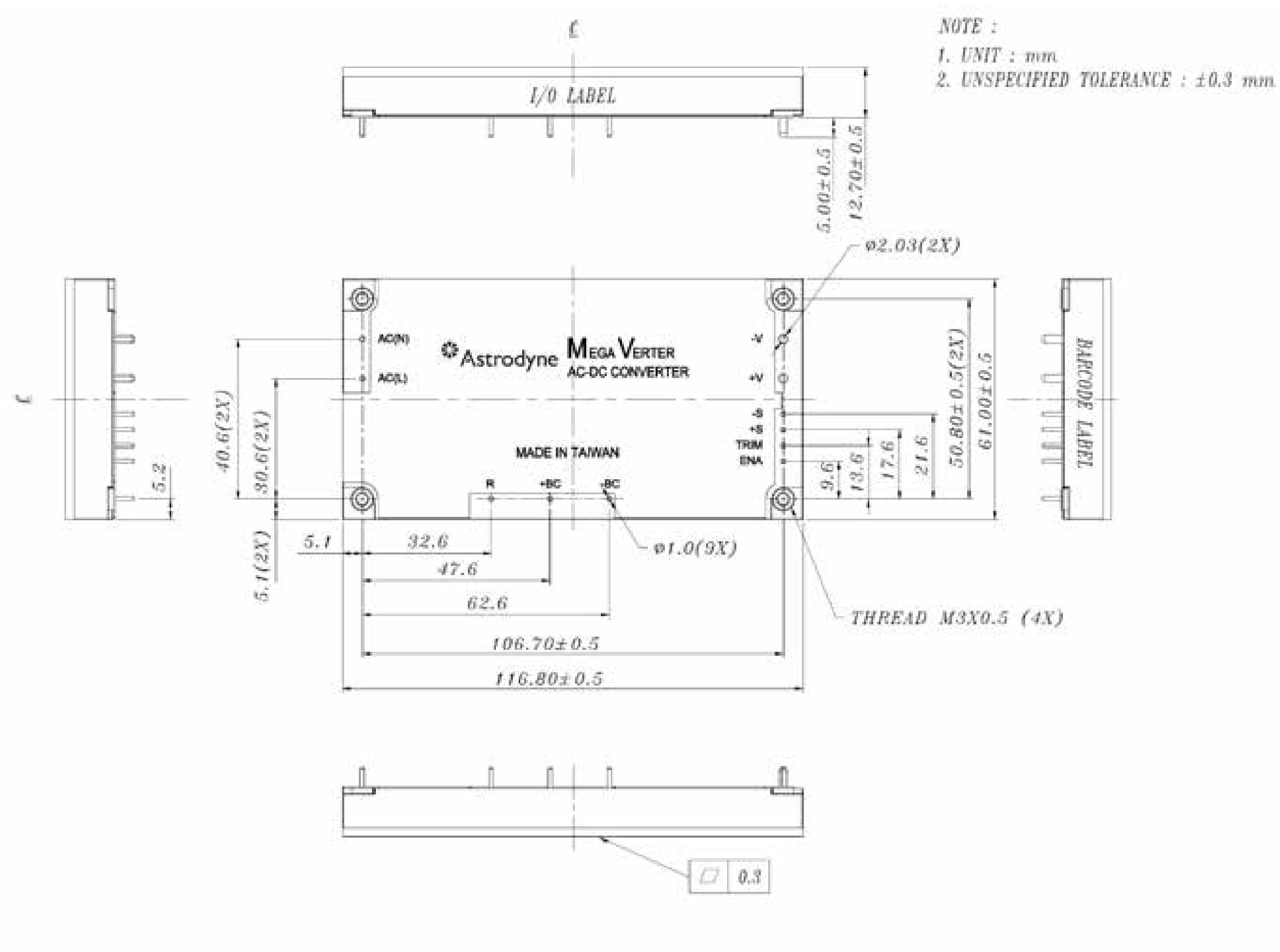


Fig. 5 Outline drawing.

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Now you have power.

SMV-12-500

500 Watt, High Efficiency, AC/DC Power Module, 12Vout

- Miniature 4.59” x 2.4” x 0.5.” Size
- High Efficiency up to 90.2% at 230VAC
- Low Output Noise
- Metal Baseplate
- Thermal Protection
- Over Voltage Protection
- Current Limit/Short Circuit Protection
- Adjustable Output Voltage: 7.7V to 14.4V
- Remote Sense
- Power On Signal (ENA) Open Collector (10mA sink current). Low (ON) when output is present

DESCRIPTION:
AC-DC Converter SMV-12-500 modules are high power density and high efficiency AC-DC converters designed for uses in telecom and other centralized modular and distributed power applications. All use metal baseplates, planar transformers, and surface mount construction to produce up to 500W maximum.

Model Number	Output Voltage	Output Amps	Input Range	Max. Iin FL	Efficiency (Tb=25°C)	O/P Set Point
SMV-12-500	12 VDC	42	85-264 VAC	6.2A	90.2% @ 230Vin	11.76-12.24VDC

All specifications are typical at nominal input, full load, and 25DegC unless otherwise noted

BAUART GEPRÜFT TYPE APPROVED TÜV Rheinland
CE
UL US

Astrodyne
Now you have power.

500 Watt, High Efficiency, AC/DC Power Module, 12Vout

SMV-12-500

ABSOLUTE MAXIMUM RATINGS (MIN TO MAX.)

Input Power with No Damage	312 VAC
Power Factor Correction	0.95 min HL-LL and Full Load
Storage Temperature / Humidity	-55 to +125°C / 10 to 95%
Operating Temperature (Note 5)	-40 to 100°C
Operating Humidity	20 to 95%
Output Power	500 Watts

INPUT SPECIFICATIONS

Input Voltage (AC(L) to AC(N)	85-265 VAC
Input Frequency	47-63 Hz
Input Current FL @ 100 Vin, FL	6.2A max.
Inrush Current (Note 3)	40A @ 265VAC

OUTPUT SPECIFICATIONS

Output Voltage & Current	See Model Selection Chart PG. 1
Output Set Point	See Model Selection Chart PG. 1
Line & Load Regulation	48mV typ. (LL-HL & NL-FL)
Ripple/Noise p-p max. (Note 1)	120mV
	48 Vout: 480mV
Dynamic Response (Note 6)	25% - 50% - 75% Load
Peak Deviation:	3% Vo, set
Settling Time	300uS
Current Limit (Note 2)	105-140% of Rated Load
Over Voltage Protection	125-145% Vo, set, Io=0.5A,
	Inverter Shutdown Method
Over Temperature Protection	Shutdown: 110°C typ.
	Auto Recovery: 90°C min.
Efficiency (Tb=25°C, FL)	88.2% @ 110 Vin
	90.2% @ 230Vin, FL
	See Fig 4 **EFFICIENCY CURVE**
External Capacitance	2000uF, Tb-25°C

STRUCTURAL DYNAMICS

Vibration	(Note 4)
Shock	196.1mS²

ISOLATION SPECIFICATIONS

Input-Output	3000VAC, 60S
Input-Case	2500VAC, 60S
Output-Case	1500VDC, 60S
Input-Output Capacitance	2000pF
Isolation Resistance	100MΩ @ Tb=25°C & 70%RH
	Output to Baseplate-500VDC

GENERAL SPECIFICATIONS

MTBF (Tb=40°C, 80%L, 220 Vin)	1.6 Mhrs
Weight	7.2 oz (206g)
Dimensions	4.59” x 0.5” x 2.4”
	(116.8 x 12.7 x 61mm)
Safety Approvals	UL: UL 60950-1-07, 2nd Edition
	TUV: EN 60950-1:2006
	CE: EN 60950-1:2006

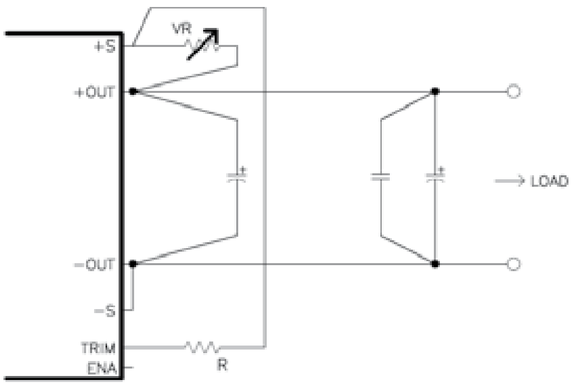
CONTROL SPECIFICATIONS

Turn-on Time	3S max., 90% Vo, set, FL
Output Voltage Adjustment Range	7.7-14.4VDC @ FL
	With Cap. 2000uF/25V Tb=25°C
	See Fig. 1 **TRIM CiRCUIT**
Hold Up Time	20mSec. min. with Cap. 780uF
	(C10 & C11 in Fig.3)

NOTES

1. Bandwidth 5Hz to 20MHz and with filter 4.7nF MLCC series 50Ω Output Capacitor: 1000uF*2, TC≥ -20°C, 1000uF*4
2. Current Limit inception point Vo=90% of Vo, set @ Tb-25°C; Auto recovery.
3. Turn on @ 264Vin, External Components are needed for operation Refer to Fig. 3 for application circuit.
4. Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm Constant (Max. 0.5g) X, Y. Z 1 Hour each, Non-Operating
5. Temperature measurement shall be taken from the baseplate (Tb). See Fig. 2 for location definition .
6. 0.25A/uS; with cap 2000uF/25V Tb=25°C, Vin=200VAC

Output Voltage Adjusted by using external resistor and/or variable resistor:



Assign R = 12.7 KΩ

$VR = 1.103Vo_{trim} - 8.488$ (UNIT:KΩ)

Fig.1 Output voltage adjusted by using external resistor and/or variable resistor

BASEPLATE MEASURE POINT:

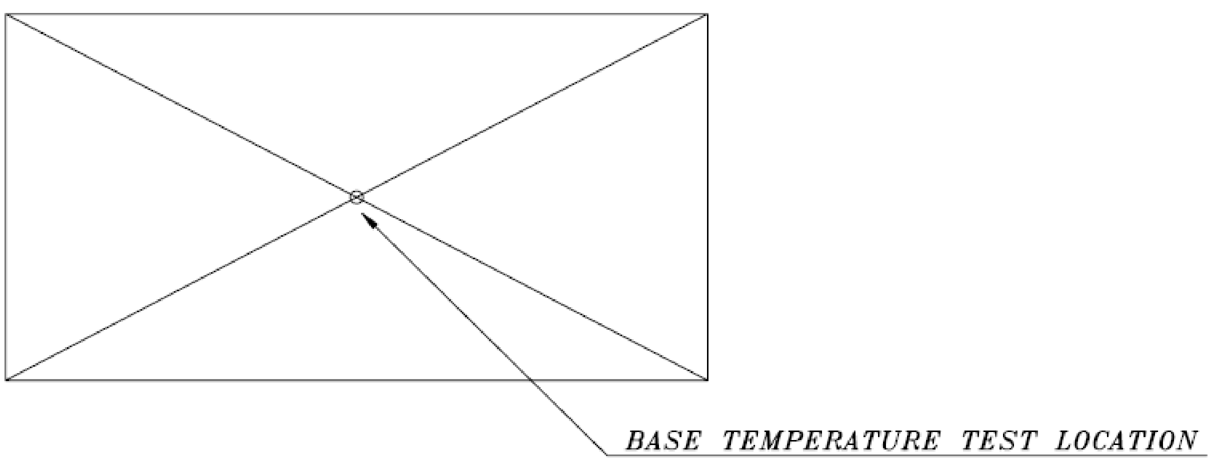
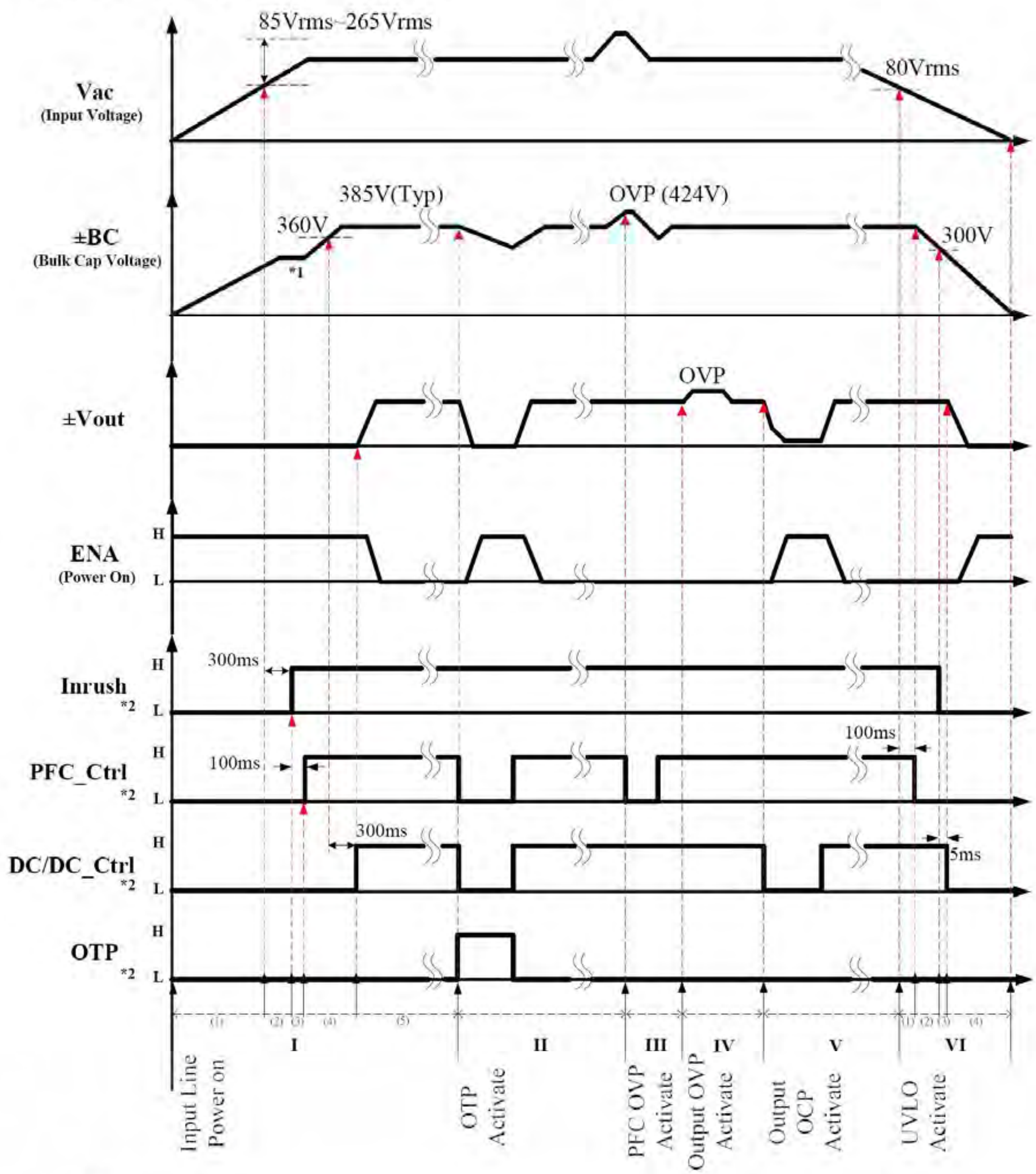


Fig.2 Baseplate Temperature Measure Point

AC/DC Block Sequence Time Chart :



Note:

*1: The voltage of bulk capacitor should be more than the rectification of 95% input voltage before inrush is high. The twenty times of RC time constant must be less than 300mS. Otherwise internal transistor of the unit could be damaged by inrush current. The time constant is equal to the product of the bulk capacitor and the external resistor.

*2: It is the internal signal of unit.
Inrush: Bypass signal for external resistor. Please refer to the description of each region.
PFC_Ctrl: Turn on/off signal. When signal is high, the PFC converter turns on. If it is low, the converter turns off.
DC/DC_Ctrl: Turn on/off signal. When signal is high, the DC/DC converter turns on. If it is low, the converter turns off.
OTP: Turn on/off signal. When signal is high, the over temperature protection is action.

◆ **Region I**：

(1) The input voltage is under 85Vrms, so the unit has no output and the ENA signal is high (open collector).

(2) Input under voltage lockout (UVLO) action. The unit starts the turn on sequence. When the input voltage reaches 85Vac and it delays 300mS, the inrush signal changes from low to high.

When the inrush signal is low, the internal transistor of the unit between R terminal and +BC terminal is open. Therefore, the inrush current can be suppressed by external resistor. When the inrush signal is high, the internal transistor of unit is short. Therefore, the external resistor is bypassed by internal transistor.

The voltage of bulk capacitors (±BC) should be more than 95% of the rectification input voltage before inrush signal changes to high. If not, the unit could be damaged by inrush current.

(3) When the inrush signal is high and then delays 100mS, the PFC_Ctrl signal changes from low to high. Which means the PFC converter turns on and the ±BC will be boosted to 385Vdc (Typ).

(4) When the PFC_Ctrl is high as well as ±BC reaches 360V and then delays 300mS, the DC/DC_Ctrl signal will change from low to high. After the steps mentioned the output voltage of unit starts to increase to specified voltage level.

(5) When the output voltage of SMV-12-500 reaches 6.3V (Typ) at start up, the ENA signal is pulled low to indicate that unit finished the turn on sequence.
The unit finished the turn on sequence through the steps above.

◆ **Region II**：The over temperature protection (OTP) action. When the baseplate temperature (refer to spec. figure 2) of the unit rises to 110℃(Typ), both PFC and DC/DC converters turns off and the output shuts down. When the baseplate temperature decreases to 90℃(Min), the output auto-recovers.

◆ **Region III**：PFC output over voltage protection (OVP) action. When ±BC is over 424V (Typ), the PFC converter turns off. The PFC output voltage auto-recovers if the failure is removed.

◆ **Region IV**：Output OVP action. The output OVP mode is clampe.

- **Region V**：Output over current protection (OCP) action. When the output current of the unit is over limitation, the output voltage steps down. If the failure mode is removed, the output voltage auto-recovers.

- **Region VI**：

(1) Input UVLO action. When the input voltage is under 80Vac (Typ) and it keeps 100mS, the PFC_Ctrl signal changes from high to low, which means that the PFC converter turns off.

The delay time (100mS) and suitable bulk capacitance can reduce the effect of input voltage dropout and meet the requirement of hold-up time. So the output voltage is stable during input voltage dropout. The recommended bulk capacitance can be referred to application circuit.

The requirement of hold up time will be reduced if the bulk capacitance is lower than the recommended and the unit is under high output power, it would trigger region VI-(2) before the end of region VI-(1).

(2) When ±BC reduces to 300V, the inrush signal changes from high to low at the same time.

(3) When the inrush is low and delays 5mS, the DC/DC_Ctrl changes from high to low, which means the DC/DC converter turns off.

(4) When the output voltage of SMV-12-500 decreases to 24.7V (Typ), the ENA signal changes from low to high.

The unit turns off through the steps of region VI.

APPLICATION CIRCUIT:

For EMI application circuit, please contact with supplier

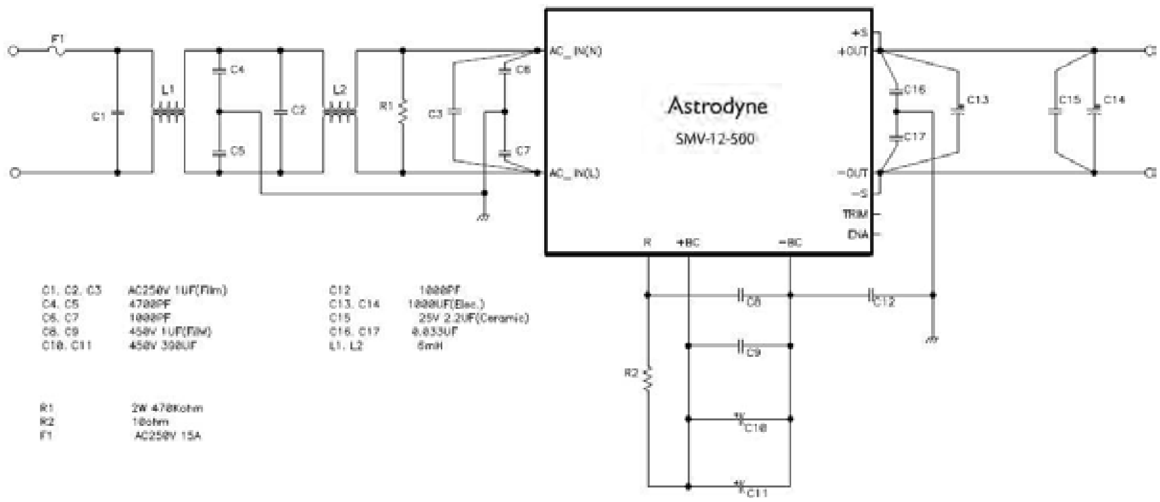


Fig.3 Application Circuit

F1: Use external fuse to meet safety standard and improve safety. Current rating of fuse must higher than application with margin. Also check the I^2t rating during inrush, transient and surge.

L1 L2: CM choke. Part of EMI filter

C1~C3: Part of EMI filter. Choose safety approved X-cap.

C4~C7: Part of EMI filter. Choose safety approved Y-cap. Check leakage current requirement for application.

R1: Bleeding resistor for safety requirement. Voltage rating and power rating should higher than application.

C8 C9: Filter cap. Check current rating and the rating should higher than application.

C10 C11: Bulk cap. The minimum required capacitance is 450V 390uF*2 for 500W output, -40degC operation and suggest to use Nippon Chemi-Con LXQ series. The figure below shows minimum required current ripple rating for bulk cap vs. output load. Make sure the selected bulk cap ripple current rating is suitable for application. Bulk cap selection also depends on input allowable dropout time. Please see section " Input voltage dropout transient immunity" for detail.

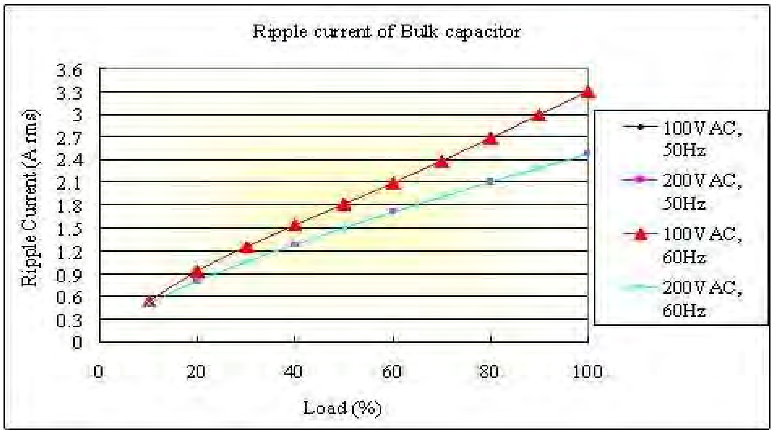


Fig.4 Bulk cap ripple current requirement vs. Output load

R2: Inrush current limit. Resistance can be calculated by formula below. Suggest to choose resistance >10ohm.

$$R = \frac{Vin_{rms} * \sqrt{2}}{Ir, pk}$$

Vin_{rms}: Input voltage

Ir,pk: Inrush current peak value.

Sufficient inrush energy withstand capacity is required. Required energy capacity can be calculated below and suggest having some design margin.

$$\frac{1}{2} C_{bulk} * (\sqrt{2} Vin_{rms})^2$$

$Cbulk$: Bulk capacitance (C10&C11)

Vin_{rms}: Input voltage.

The selected inrush resistor R2 have to meet the formula below, if the resistor value over the limitation may cause the brick damage.

$$R < \frac{300mS}{20 * C_{bulk}}$$

$Cbulk$: Bulk capacitance (C10&C11)

C12: Part of EMI filter. Choose safety approved Y-cap.

C13 C14: E-cap to reduce output ripple and ensure stability. Choose low ESR part and check the ripple current rating higher than application. Suggest at least 470uF*2 if Tb>-20℃ and 470uF*4 if -40℃<Tb<-20℃.

C15: Connect ceramic capacitor near output terminal to reduce output noise.

C16 C17: Ceramic or film capacitor for EMI filtering. High voltage rating is required for isolation requirement.

INPUT VOLTAGE DROPOUT TRANSIENT IMMUNITY:

The output voltage should immune input voltage dropout. The allowable dropout time is related to output power and bulk capacitance (C10&C11) and Vo. Dropout time is longer with higher capacitance or lower output power. But the maximum allowable dropout time is **60mS** regardless of capacitance and output power. The formula of allowable dropout time is shown below.

$$C_{bulk} = \frac{2(P_o * T_{holdup}) * 1000}{(385^2 - 320^2) * 0.92}$$

For Vo≦ 12V

$$C_{bulk} = \frac{2(P_o * T_{holdup}) * 1000}{(385^2 - (320 * Vo/12)^2) * 0.92}$$

For Vo>12V

Cbulk: Bulk capacitance (uF)

Po: Output power (W)

Tholdup: Allowable dropout time (mS)

For example, if required dropout time is 20mS at Po=500W, Vo=12V, the Cbulk capacitance must higher than 475uF, Note that capacitance tolerance need to take into account and must fulfill the minimum capacitance 390*2uF requirement for -40degC operation. Note that the maximum allowable dropout time is 60mS even the calculation result over 60mS.

EFFICIENCY CURVE:

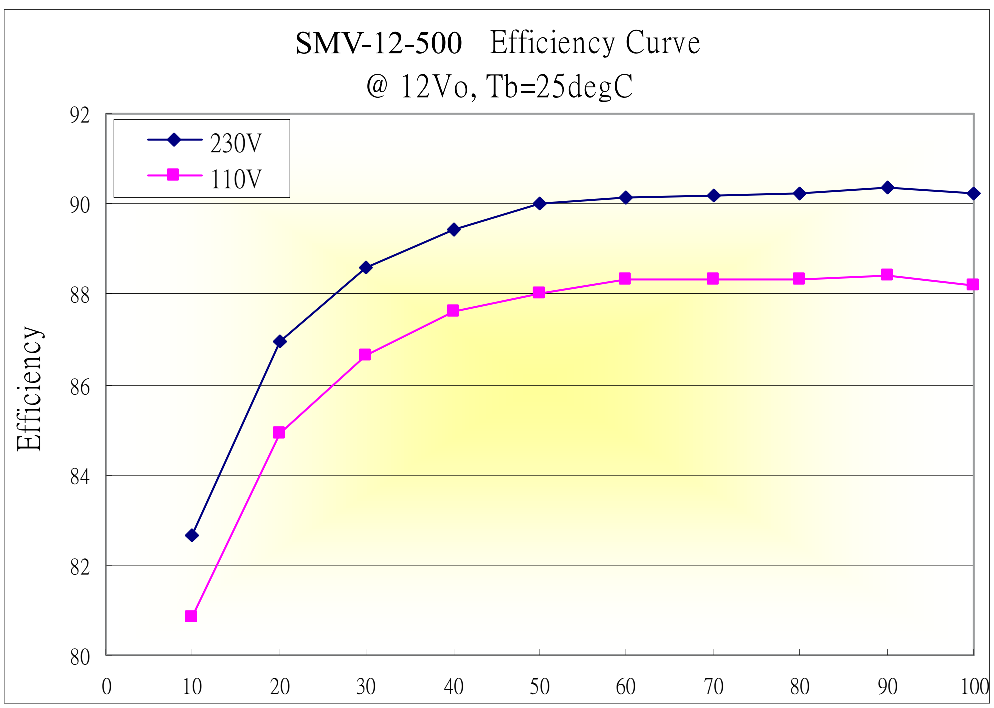


Fig.5 Efficiency curve

MECHANICAL DIMENSIONS

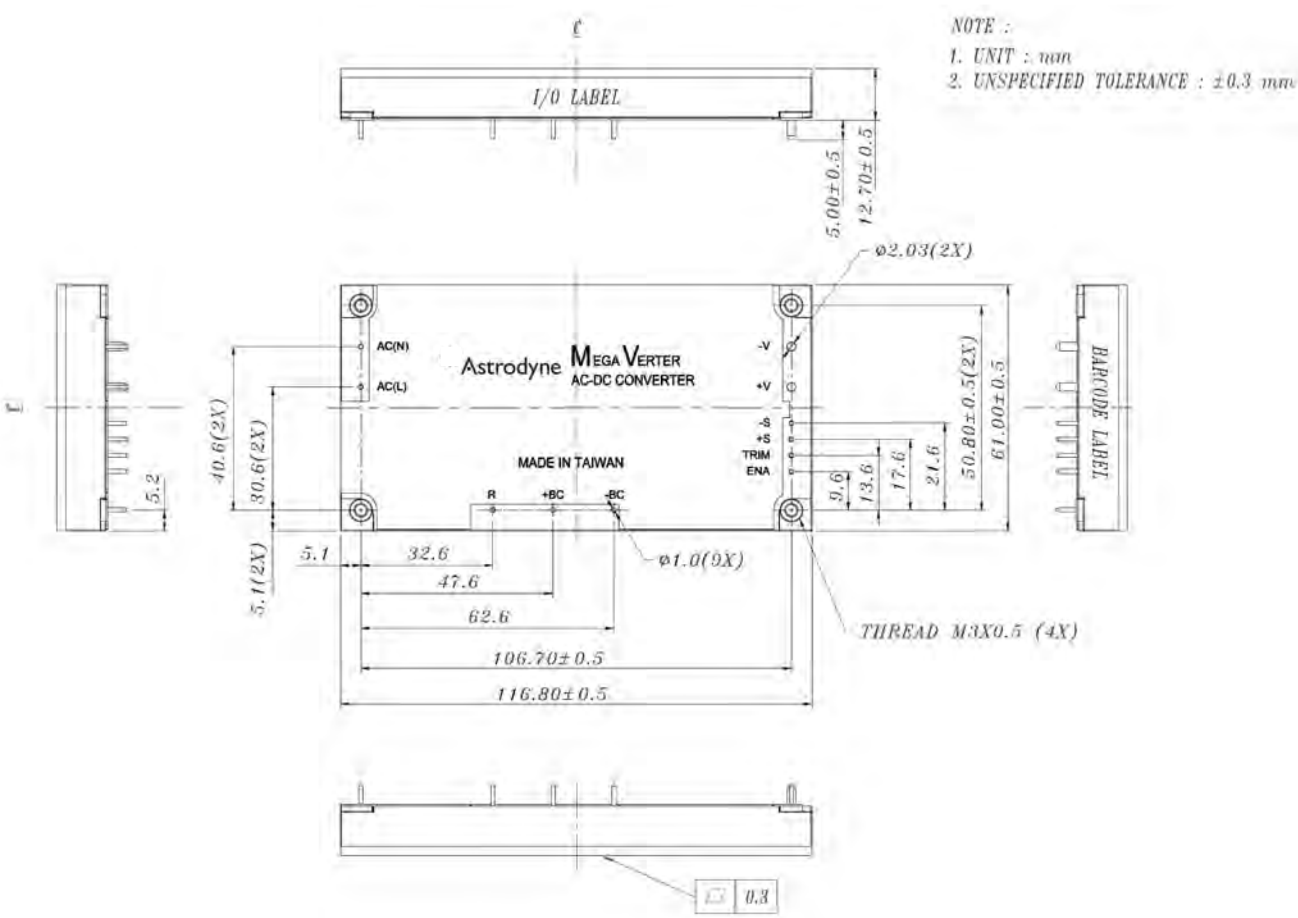


Fig. 5 Outline drawing.

UV28 MICROVERTER® SERIES

126-252 WATTS   28VDC INPUT   3/4 BRICK SINGLES   FULL BRICK TRIPLES

DESCRIPTION

The µV28 Series are high density DC-DC converters designed for use in telecom and other centralized modular and distributed power applications. The µV28 Series use metal PC boards, planar transformers, and surface mount construction to produce up to 252 watts in a tiny package.

FEATURES

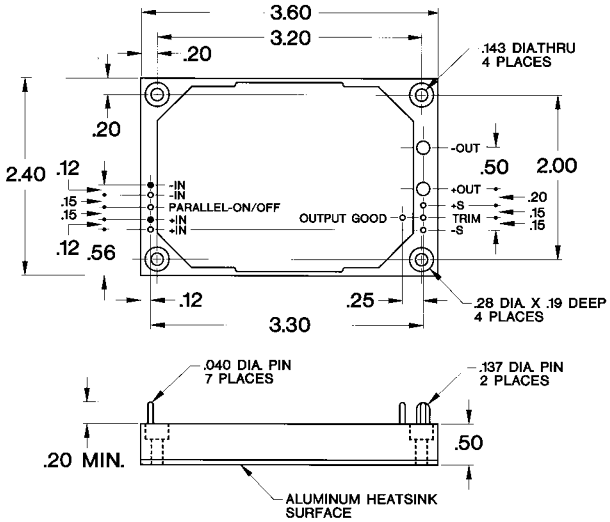
- Miniature Size
- High Density – Up to 58 W/in.3
- Constant Frequency – 370KHZ
- Parallelable with Current Sharing
- Fault Tolerant – n+m Redundancy
- Extremely Low Thermal Resistance
- Output Good Signal
- Optional Sync Pin
- Non-Shutdown OVP
- Logic On-Off
- Thermal Protection
- Current Limit/Short Circuit Protection

MODEL SELECTION

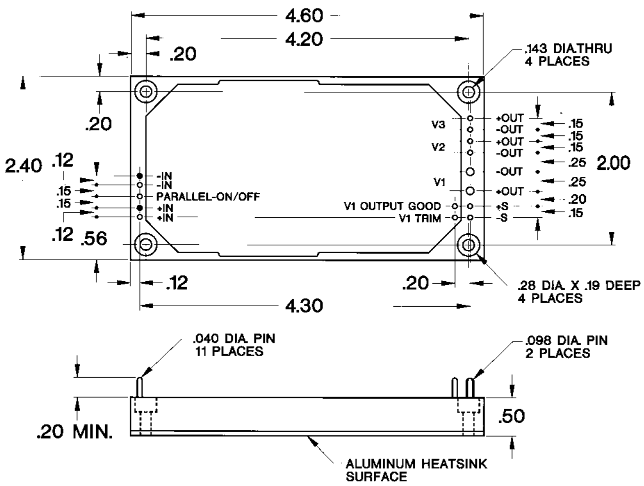
Model	Output Voltage	Output Current
µV28-3	3.3V	50A
µV28-5	5V	40A
µV28-8	8V	30A
µV28-12	12V	20A
µV28-15	15V	16A
µV28-24	24V	10A
µV28-28	28V	9A
µV28-T512	5V	35A*
	12V	3A*
	-12V	3A*
µV28-T515	5V	35A*
	15V	3A*
	-15V	3A*

*Maximum Total Output Power 185 W.
Option:– A Output Good Deleted
– S Sync. Pin Option

SINGLE OUTPUT



TRIPLE OUTPUT



UV28 MICROVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Units	Conditions
INPUT	Input voltage	20	28	32	VDC	
	Brownout	18			VDC	75% full output
	In rush charge		2.6x10-4		Coulombs	
	Input reflected ripple		20		%	Full Load, nominal line
	No load power dissipation		1.5		watts	singles
			7.5		watts	triples
	Logic disabled power in		.35		watts	
	Input ripple rejection		60		dB	@ 120 Hz
	Input overvoltage	32		60	VDC	no damage to units
OUTPUT	(Singles and Main Output of Triple)					
	Set point accuracy			±1	%	no load
	Load regulation		.02	.2	%	0 to Full Load
	Line regulation		.02	.2	%	over range
	Ripple		1	3	%p-p	0 to 20MHz
	Trim range	±10			%	consult factory for extended range
	Remote sense compensation			0.5	V total	
	OVP (non shutdown auto. recovery)		120*		%	* or Vout +.5V whichever is greater
	Current Limit (auto.recovery)		110-120		%	Full Load
	Current sharing (automatic)		±5		%	Full ILoad
	Transient response singles		50		μs	20-80% load,.5A/μs, Vout 1%
	Transient response main output triples	200			μs	10-20A, aux. loads 2.5A, .25A/μs, Vout 1%
	Transient response	*See website: www.astrodyne.com*				
	Temp drift			.02	%/°C	
	Efficiency	*See Curves on Page 58*				
OUTPUT	(Auxiliary Outputs of Triples)					
	Set point accuracy		±0.5	±1	%	10A on main, no load auxiliaries
	Load regulation		.2	.5	%	0 to full load
	Line regulation		.01	.1	%	over range
	Ripple		.25	.5	%p-p	0 to 20 mHz
	Current Limit (auto.recovery)		110-120		%	Full Load
	Transient response		200		μs	20-80% load, Vout within 1%
	Transient response		200		μs	low line to high line, Vout 1%
	Transient response		200		μs	50-100% load, Vout 1%
	Temp drift		.06		%/°C	
CONTROL	Turn on time		2.5		ms	input power applied, Vout 1%
	Logic turn on time		1		ms	Vout within 1%
	Logic disabled current		1		mA	sink
ISOLATION	Input to output	1000			VDC	consult factory for procedure
	Input to case	1000			VDC	
	Output to case	200			VDC	
	Input to output capacity		2200		pF	
THERMAL	Operating temperature	-40		+100	°C case	
	Automatic shut down temperature	+100	+105	+110	°C case	
	Thermal resistance case to ambient		4.2		°C/w	single @ Tc=100°C
			3.3		°C/w	triple @ Tc=100°C
WEIGHT	singles		7		oz.	
	triples		9		oz.	
SIZE	singles		0.5x2.4x3.6		inches	
	triples		0.5x2.4x4.6		inches	

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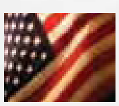
sales@astrodyne.com

uV24-12-164

MicroVerter® 164 DC-DC Converter

24 VDC Input
300 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.



MADE IN U.S.A.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV24-12-164	18-36 VDC	12 (10.8-13.2 VDC)	25A

uV24-12-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV24-12-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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Astrodyne USA: 1-800-823-8082
Astrodyne Pacific: 886-2-26983458

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+In to -In)		-0.3	36	Vdc	Continuous
Transient Input Voltage (+In to -In)		-0.3	50	Vdc	100ms max.
Parallel Pin Voltage (Parallel-On/Off to -In)		-0.3	6.0	Vdc	
Input-to-Output Voltage			1500	Vdc	
Input-to-Case Voltage			1500	Vdc	
Output-to-Case Voltage			500	Vdc	
Storage Temperature	Standard	-40	110	°C	
	T	-55	110	°C	
	E	-55	125	°C	
Operating Temperature	Standard	-40	100	°C	Baseplate
	T	-55	100	°C	Baseplate
	E	-55	125	°C	Baseplate
Soldering Temperature			260	°C	< 5 sec

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=28VDC, Vout=12VDC, Full Load, Tc=25 °C unless specified otherwise

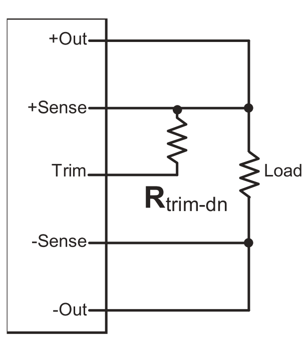
Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage Range	18	24 / 28	36	Vdc	
Maximum Input Current		19.4		Adc	Vin = 18V, Tc = 25°C
			19.8	Adc	Vin = 18V, Tc = 100°C
Input Ripple Rejection		60		dB	f = 120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	11.88	12.01	12.12	Vdc	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift with Temperature			0.02	%/°C	Tc min to Tc max
Ripple (PARD)		120	240	mV p-p	Vin = 28V, Tc = 25°C
			360	mV p-p	18V ≤ Vin ≤ 36V, -40°C ≤ Tc ≤ +100°C
Rated Current	0		25	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout = 95% Vout nominal
Short Circuit Current			170	% Rated	18V ≤ Vin ≤ 36V, Rshort = 15 mOhm
Transient Response Deviation		480		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs
Efficiency		88.0		%	Vin = 28V, Iout = 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output Isolation	1500			Vdc	Consult factory for procedure
Input-to-Case Isolation	1500			Vdc	
Output-to-Case Isolation	500			Vdc	
Input-to-Output Capacitance		2500		pF	
Input-to-Output Resistance	10			M Ohm	500V

ELECTRICAL SPECIFICATIONS Continued

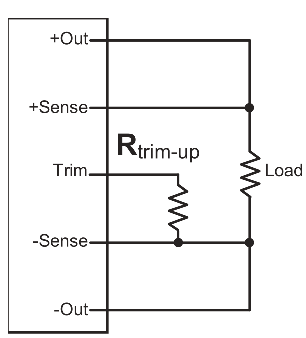
Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp.	Standard and T		105		°C	
	E		130			
Over Temperature Restart Temp.	Standard and T		85		°C	
	E		105			
Start-up Voltage		16.5	17.0	17.5	V	
Input Under Voltage Lock Out		15.0	15.5	16.0	V	
Turn-on Time			5	10	ms	18V ≤ Vin ≤ 36V, Tc = 25°C
				12	ms	18V ≤ Vin ≤ 36V, -40°C < Tc < +100°C
Logic On/Off Enable Signal			Open		V	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	V	I On/Off = 1mA.
Logic On/Off Turn-on Time			5	10	ms	
Trim Range		9.6		13.2	V	See Trim Formula and Diagrams
OVP Trip Point		14.7	14.9	15.8	V	Non-shutdown, Auto Recovery, Iout = 50% Rated
Remote Sense Compensation				0.5	V	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		kHz	Standard Model
			300		kHz	-S Sync Option Model
Synchronization Frequency Range		330		440	kHz	Using Optional Sync Pin and External Sync Signal

Thermal / Mechanical Parameters	Minimum	Typical	Maximum	Units	Conditions
Thermal Resistance, Case to Ambient		4.2		°C/W	Free Air, No Heatsink, Tc=100°C
Size, HxWxL		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (gm)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{29.01K\Omega}{\Delta V}$$

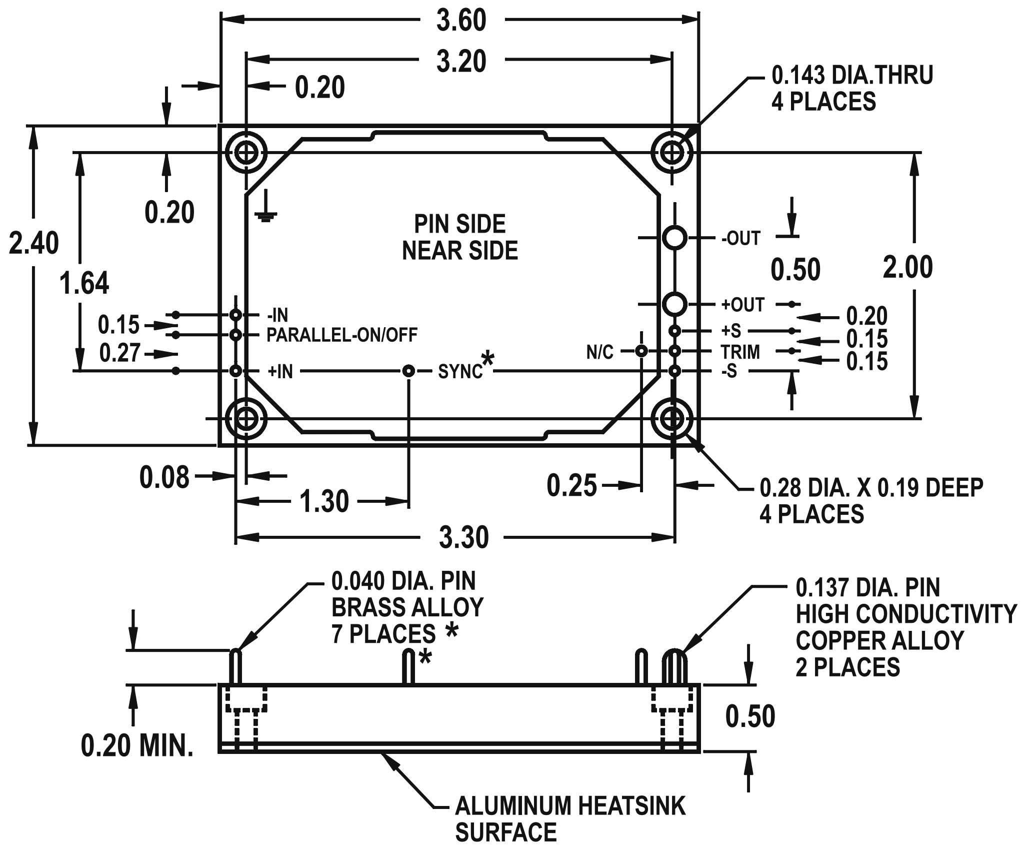
$$R_{trim\text{-}down} = \frac{203.0-19.34\Delta V}{\Delta V} K\Omega$$

ΔV = | Desired Output Voltage Change (Volts) |

$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 8 places when ordering sync option.
Location of optional sync pin shown.

NOTES

Astrodyne Corporation
375 Forbes Blvd.
Mansfield, MA 02048

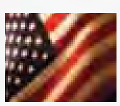
Tel: (508) 964-6300
Fx: (508) 339-0375
sales@astrodyne.com

uV24-15-164

MicroVerter® 164 DC-DC Converter

24/28 VDC Input
300 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.



MADE IN U.S.A.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV24-15-164	18-36 VDC	15 (10.0-16.5VDC)	20A

uV24-15-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV24-15-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+In to -In)		-0.3	36	Vdc	Continuous
Transient Input Voltage (+In to -In)		-0.3	50	Vdc	100ms max.
Parallel Pin Voltage (Parallel-On/Off to -In)		-0.3	6.0	Vdc	
Input-to-Output Voltage			1500	Vdc	
Input-to-Case Voltage			1500	Vdc	
Output-to-Case Voltage			500	Vdc	
Storage Temperature	Standard	-40	110	°C	
	T	-55	110	°C	
	E	-55	125	°C	
Operating Temperature	Standard	-40	100	°C	Baseplate
	T	-55	100	°C	Baseplate
	E	-55	125	°C	Baseplate
Soldering Temperature			260	°C	< 5 sec

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=28VDC, Vout=12VDC, Full Load, Tc=25 °C unless specified otherwise

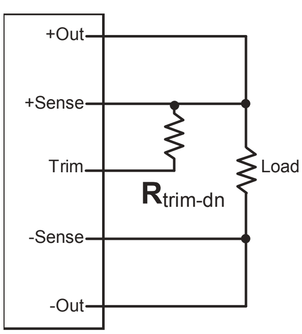
Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage Range	18	24 / 28	36	Vdc	
Maximum Input Current		19.4		Adc	Vin = 18V, Tc = 25°C
			19.8	Adc	Vin = 18V, Tc = 100°C
Input Ripple Rejection		60		dB	f = 120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	14.85	15.01	15.15	Vdc	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift with Temperature			0.02	%/°C	Tc min to Tc max
Ripple (PARD)		100	300	mV p-p	Vin = 28V, Tc = 25°C
			450	mV p-p	18V ≤ Vin ≤ 36V, -40°C ≤ Tc ≤ +100°C
Rated Current	0		20	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout = 95% Vout nominal
Short Circuit Current			170	% Rated	18V ≤ Vin ≤ 36V, Rshort = 15 mOhm
Transient Response Deviation		750		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs
Efficiency		88.0		%	Vin = 28V, Iout = 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output Isolation	1500			Vdc	Consult factory for procedure
Input-to-Case Isolation	1500			Vdc	
Output-to-Case Isolation	500			Vdc	
Input-to-Output Capacitance		2500		pF	
Input-to-Output Resistance	10			M Ohm	500V

ELECTRICAL SPECIFICATIONS Continued

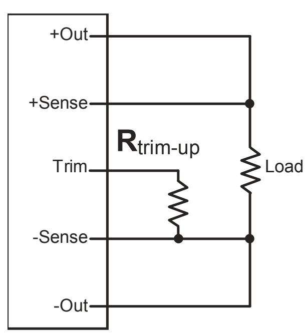
Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp.	Standard and T		105		°C	
	E		130			
Over Temperature Restart Temp.	Standard and T		85		°C	
	E		105			
Start-up Voltage		16.5	17.0	17.5	V	
Input Under Voltage Lock Out		15.0	15.5	16.0	V	
Turn-on Time			5	10	ms	18V ≤ Vin ≤ 36V, Tc = 25°C
				12	ms	18V ≤ Vin ≤ 36V, -40°C < Tc < +100°C
Logic On/Off Enable Signal			Open		V	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	V	I On/Off = 1mA.
Logic On/Off Turn-on Time			5	10	ms	
Trim Range		10.0		16.5	V	See Trim Formula and Diagrams
OVP Trip Point		16.7	17.9	19.8	V	Non-shutdown, Auto Recovery, Iout = 50% Rated
Remote Sense Compensation				0.5	V	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		kHz	Standard Model
			300		kHz	-S Sync Option Model
Synchronization Frequency Range		330		440	kHz	Using Optional Sync Pin and External Sync Signal

Thermal / Mechanical Parameters	Minimum	Typical	Maximum	Units	Conditions
Thermal Resistance, Case to Ambient		4.2		°C/W	Free Air, No Heatsink, Tc=100°C
Size, HxWxL		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (gm)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{29.84\,K\Omega}{\Delta V}$$

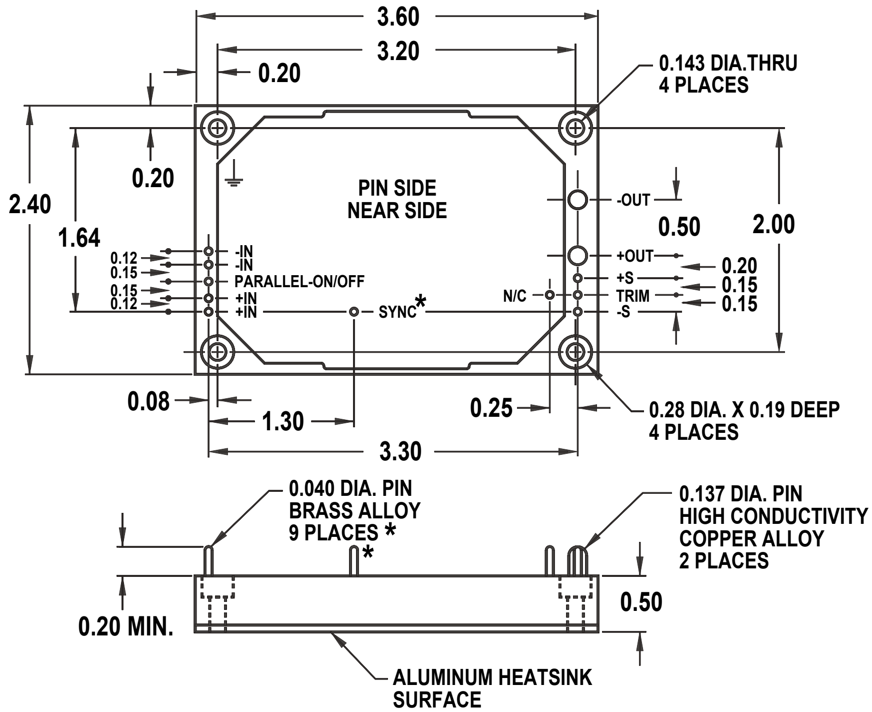
$$R_{trim\text{-}down} = \frac{268.5 - 19.89\,\Delta V}{\Delta V}\ K\Omega$$

ΔV = | Desired Output Voltage Change (Volts) |

$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 10 places when ordering sync option.
Location of optional sync pin shown.

NOTES

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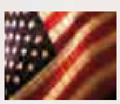
uV24-24-164

MicroVerter® 164 DC/DC Converter

24/28 VDC Input
300 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.



MADE IN U.S.A.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV24-24-164	18-36 VDC	24 (19.2-26.4 VDC)	12.5A

uV24-24-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV24-24-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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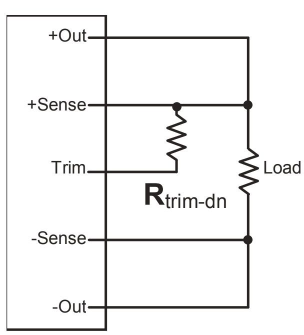
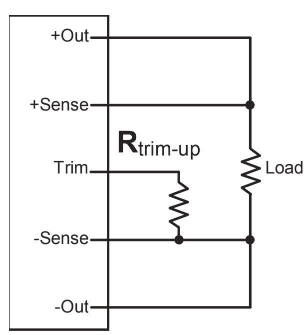
ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp.	Standard and T		105		°C	
	E		130			
Over Temperature Restart Temp.	Standard and T		85		°C	
	E		105			
Start-up Voltage		16.5	17.0	17.5	V	
Input Under Voltage Lock Out		15.0	15.5	16.0	V	
Turn-on Time			5	10	ms	18V ≤ Vin ≤ 36V, Tc = 25°C
				12	ms	18V ≤ Vin ≤ 36V, -40°C < Tc < +100°C
Logic On/Off Enable Signal			Open		V	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	V	I On/Off = 1mA.
Logic On/Off Turn-on Time			5	10	ms	
Trim Range		19.2		26.4	V	See Trim Formula and Diagrams
OVP Trip Point		28.3	29.8	31.7	V	Non-shutdown, Auto Recovery, Iout = 50% Rated
Remote Sense Compensation				0.5	V	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		kHz	Standard Model
			300		kHz	-S Sync Option Model
Synchronization Frequency Range		330		440	kHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters		**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		°C/W	Free Air, No Heatsink, Tc=100°C
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (gm)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{62.16\ K\Omega}{\Delta V}$$

$$R_{trim\text{-}down} = \frac{932.3 - 41.44\ \Delta V}{\Delta V}\ K\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

RO

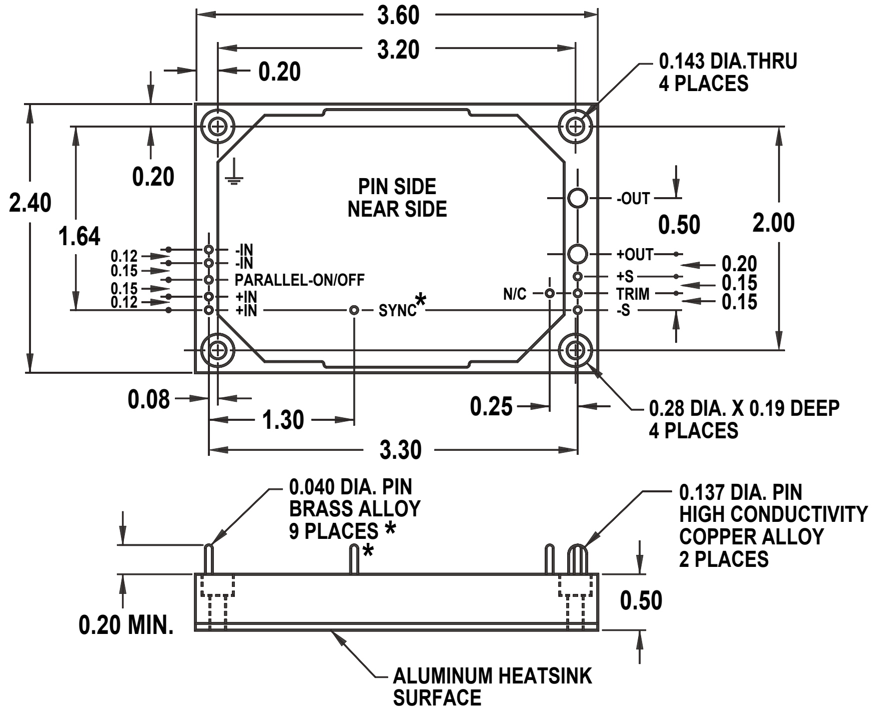
ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+In to -In)		-0.3	36	Vdc	Continuous
Transient Input Voltage (+In to -In)		-0.3	50	Vdc	100ms max.
Parallel Pin Voltage (Parallel-On/Off to -In)		-0.3	6.0	Vdc	
Input-to-Output Voltage			1500	Vdc	
Input-to-Case Voltage			1500	Vdc	
Output-to-Case Voltage			500	Vdc	
Storage Temperature	Standard	-40	110	°C	
	T	-55	110	°C	
	E	-55	125	°C	
Operating Temperature	Standard	-40	100	°C	Baseplate
	T	-55	100	°C	Baseplate
	E	-55	125	°C	Baseplate
Soldering Temperature			260	°C	< 5 sec

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=28VDC, Vout=12VDC, Full Load, Tc=25 °C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage Range	18	24 / 28	36	Vdc	
Maximum Input Current		19.9		Adc	Vin = 18V, Tc = 25°C
			20.2	Adc	Vin = 18V, Tc = 100°C
Input Ripple Rejection		60		dB	f = 120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	23.76	24.01	24.24	Vdc	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift with Temperature			0.02	%/°C	Tc min to Tc max
Ripple (PARD)		170	300	mV p-p	Vin = 28V, Tc = 25°C
			450	mV p-p	18V ≤ Vin ≤ 36V, -40°C ≤ Tc ≤ +100°C
Rated Current	0		12.5	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout = 95% Vout nominal
Short Circuit Current			170	% Rated	18V ≤ Vin ≤ 36V, Rshort = 15 mOhm
Transient Response Deviation		1200		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs
Efficiency		88.0		%	Vin = 28V, Iout = 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output Isolation	1500			Vdc	Consult factory for procedure
Input-to-Case Isolation	1500			Vdc	
Output-to-Case Isolation	500			Vdc	
Input-to-Output Capacitance		2500		pF	
Input-to-Output Resistance	10			M Ohm	500V

OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 10 places when ordering sync option.
Location of optional sync pin shown.

NOTES

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Mansfield, MA 02048

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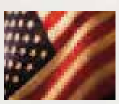
sales@astrodyne.com

uV24-28-164

MICROVERTER® 164 DC/DC Converter

24/28 VDC Input
300 Watts
3/4 Brick

The MICROVERTER® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MICROVERTER® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.



MADE IN U.S.A.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV24-28-164	18-36 VDC	28 (25.2-30.8 VDC)	11A

uV24-28-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV24-28-STC-164RL
Synchronization, -55 °C to 100 °C, Conformal Coating, No Pure Tin

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	36	VDC	Continuous
Transient Input Voltage (+ In to -In)		-0.3	50	VDC	100 msec. Max.
Parallel Pin Voltage (Parallel-On/Off to -In)		-0.3	6.0	VDC	
Input-to-Output Voltage			1500	VDC	
Input-to-Case Voltage			1500	VDC	
Output-to-Case Voltage			500	VDC	
Storage Temperature	Standard	-40	+110	°C	
	T	-55	+110	°C	
	E	-55	+125	°C	
Operating Temperature	Standard	-40	+100	°C	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	°C	< 5 sec

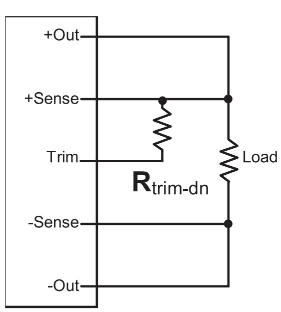
ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=28VDC, Full Load, Tc=25°C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage Range	18	24 / 28	36	VDC	
Maximum Input Current		19.9		ADC	Vin= 18V, Tc= 25°C
			20.2	ADC	Vin=18V, Tc=100°C
Input Ripple Rejection		60		dB	f= 120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	27.72	28.01	28.28	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		170	300	mV p-p	Vin= 28V, Tc= 25°C
			450	mV p-p	18V≤ Vin≤ 36V, -40°C≤ Tc≤ +100°C
Rated Current	0		11	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout = 95% Vout nominal
Short Circuit Current			170	% Rated	18V≤ Vin≤ 36V, Rshort=15 mOhm
Transient Response Deviation		1400		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs
Efficiency		88.5		%	Vin= 28V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	1500			VDC	Consult factory for procedure
Input-to-Case	1500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		2500		pF	
Input-to-Output Resistance	10			M Ohm	500V

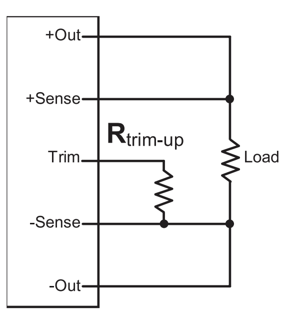
ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard and T		105		°C	
	E		130			
Over Temperature Restart Temp (Tc)	Standard and T		85		°C	
	E		105			
Start-up Voltage		16.5	17.0	17.5	VDC	
Input Under Voltage Lock Out		15.0	15.5	16.0	VDC	
Turn-on Time			5	10	msec	18V≤ Vin≤ 36V, Tc=25°C
				12	msec	18V≤ Vin≤ 36V, -40°C<Tc< +100°C
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off = 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		25.2		30.8	VDC	See Trim Formula and Diagrams
OVP Trip Point		31.2	32.9	35.0	VDC	Non-shutdown, Auto Recovery, Iout = 50% Rated
Remote Sense Compensation				0.5	VDC	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Synchronization Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters		**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		°C/W	Free Air, No Heatsink, Tc= 100°C
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{62.75K\ \Omega}{\Delta V}$$

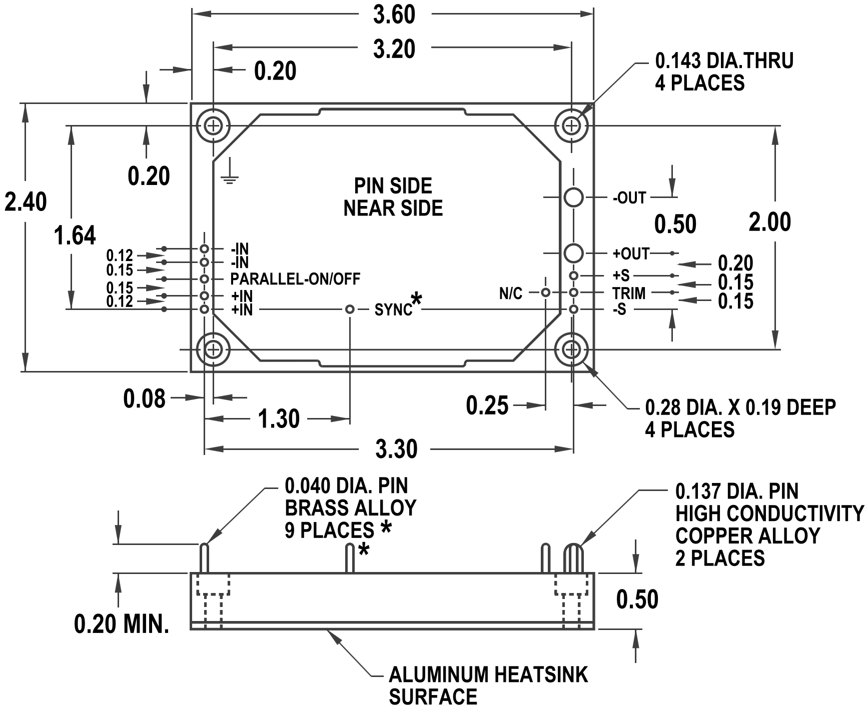
$$R_{trim\text{-}down} = \frac{1109-41.83\ \Delta V}{\Delta V}\ K\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

$R_{trim\text{-}up} =$ External Resistor Value to Increase V_{out}

$R_{trim\text{-}down} =$ External Resistor Value to Decrease V_{out}

OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 10 places when ordering sync option.
Location of optional sync pin shown.

NOTES

SV28 SUPERVERTER® 150/175/200 SERIES

75-240 WATTS 28VDC INPUT 1/2 BRICK INDUSTRY STANDARD

DESCRIPTION

The SuperVerter 28 Series are high power density and high dynamic response DC-DC converters designed for use in telecom, wireless, and other centralized modular or distributed power systems using 24V input. The SuperVerter 28 family of DC-DC converters may be used as form, fit, function replacements for the industry standard half bricks.

FEATURES

- Direct Replacement for Industry Standard
- High Efficiency
- High MTBF (1.8 million hours)
- Constant Frequency
- Clamp Over Voltage Protection
- Remote Sense
- Trim Range: 60% to 110%
- Encapsulated
- High Power Density
- Low Noise
- -40° to +100° C Baseplate Operation
- Choice of On/Off Logic
- Safety Agency Approved
- Threaded or Thru Mounting Holes
- Optional Pin lengths
- Over Temperature Protection

MODEL SELECTION

Model	Output Voltage	Output Current
28 VDC		
(18-36V)		
SV28-3.3-150-1	3.3V	30A
SV28-3.3-200-1	3.3V	40A
SV28-5-150-1	5V	30A
SV28-5-175-1	5V	35A
SV28-5-200-1	5V	40A
SV28-12-150-1	12V	12.5A
SV28-12-200-1	12V	20.0A
SV28-24-150-1	24V	6.3A
SV28-24-200-1	24V	10A
SV28-28-150-1	28V	5.35A
SV28-28-200-1	28V	8.60A

OPTIONAL FEATURES

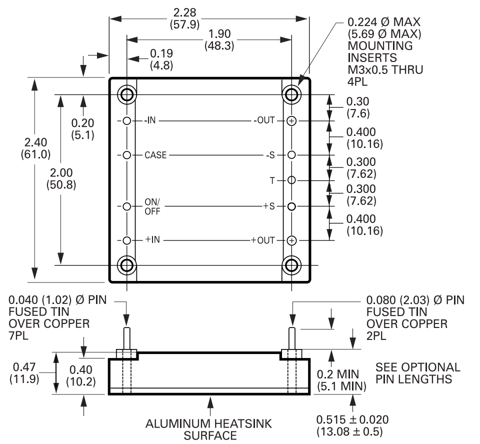
For the optional features listed below, simply list the appropriate digit(s) for the features you want in ascending order in the suffix following -150 to -200 in the part number

Feature Options	Suffix
Negative Logic On/Off is standard	include "1" in the suffix
Positive Logic On/Off is optional	delete "1" from the suffix
Threaded mounting holes, as shown in the outline drawing are standard	no suffix digit required
Optional thru mounting holes (without threads) of 0.130" inside diameter*	include "4" in the suffix
Pin length of 0.20" (5.1mm) is standard	no suffix digit required
Pin length of 0.145" (3.68mm)*	include "6" in the suffix
Pin length of 0.110" (2.79mm)*	include "8" in the suffix

** Minimum order quantities apply.*

Examples:

SV28-5-150-1 Standard module negative logic, threaded inserts, 0.20 inch pins.
SV28-5-150-48 Positive logic, through hole inserts, 0.110 inch pins.
SV28-5-150-146 Negative logic, through hole inserts, 0.145 inch pins.



SV28 SUPERVERTER (150/175/200) SERIES SPECIFICATIONS

		Min	Typical	Max	Units	Conditions
Absolute Maximum Ratings: Exceeding absolute maximum ratings may cause permanent damage or reduce reliability.						
PARAMETER	Input Voltage			40	Vdc	Continuous
	Transient Input Voltage			50	Vdc	100 msec max.
	Input/Output Isolation			1500	Vdc	
	Operating Case Temperature	-40		100	°C	
	Storage Temperature	-40		110	°C	
Electrical Specifications: Apply over the entire range of input voltage, output current, and temperature unless indicated.						
INPUT	Input Voltage	18	28	36	Vdc	
	Maximum Input Current	*See web site: www.astrodyne.com*				
	Input Ripple Rejection		60		dB	@120 Hz
OUTPUT	Voltage Set Point			2	%	48V In, Full Load 25°C
	Load Regulation		0.05	0.2	%	0 to Full Load
	Line Regulation		0.01	0.1	%	Over Vin Range
	Voltage Drift w/Temperature					
	Ripple	*See web site: www.astrodyne.com*				
	Current	*See Model Selection*				
	Current Limit Inception		115	130	% Iout max.	Vout = 90% Vout nominal, *See Output Characteristic Curves*
	Short Circuit Current			170	% Iout max	Vout = 250 mV, *See Output Characteristic Curves*
	Transient Response Peak Deviation (0.1A/µsec slew rate)		3		% Vout	50 to 75% or 50 to 25% Load Change
	Transient Response Settling Time (0.1A/µsec slew rate)		300		µsec	Vout within 1% Vout nominal
	Efficiency	*See Curves on Page 56 or web site: www.astrodyne.com*				
	External Load Capacitance	0		10,000	µF	
ISOLATION	Input to Output Capacitance		2000		pF	
	Input to Output Resistance	10			M ohms	
	Input to Output		1500		Vdc	
	Input to Case		1500		Vdc	
	Output to Case		500		Vdc	
MECHANICAL	Weight		118 (4.2)		g (oz.)	
	Size		0.5x2.4x2.28		inches	*See Outline Drawing*
	Thermal Resistance Case to Ambient		6.6		°C/W	Case Temperature = 100°C
FEATURES	Trim Range	60		110	%Vout	
	Remote Sense Compensation			0.5	V	
	Over Voltage Clamp	*See web site: www.astrodyne.com*				
	Over Temperature Shut-down		105		°C	Case Temperature *(Not in 50W and 75W models)*
	Logic On/Off					
	Logic Low: Von/off	0		1.2	V	@ Ion/off = 1 mA
	Ion/off			1.0	mA	@ Von/off = 0V
	Logic High: Von/off			15	V	@ Ion/off = 1 mA
	Ion/off			50	µA	@ Von/off = 15V
	Turn-on Time		8	35	msec	80% load, Vout within 1% Vout nominal

100 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Astrodyne RO
Now you have power.

Description

The 4:1 Input Voltage 100 W single ASD Series of DC/DC converters provide precisely regulated dc outputs. The output voltage is fully isolated from the input, allowing the output to be positive or negative polarity and with various ground connections. The ASD Series utilizes an insulated metal substrate design in an industry standard 1/2 brick case size to meet the most rigorous requirements of COTS and thermally challenging industrial applications.

The 4:1 Input Voltage 100 Watt ASD Series includes remote sensing, output trim, and remote ON/OFF. Threaded-through holes are provided to allow easy mounting or add a heat sink for extended temperature use.

Selection Chart					
Model	Input Range VDC		Iin ADC	Vout VDC	Iout ADC
	Min	Max	TYP		
ASD100-24S3.3W	9	36	4.24	3.3	25
ASD100-24S5W	9	36	4.91	5	20
ASD100-24S12W	9	36	4.85	12	8.33
ASD100-24S15W	9	36	4.79	15	6.67
ASD100-24S24W	9	36	4.79	24	4.13
ASD100-48S3.3W	18	75	2.10	3.3	25
ASD100-48S5W	18	75	2.42	5	20
ASD100-48S12W	18	75	2.39	12	8.33
ASD100-48S15W	18	75	2.37	15	6.67
ASD100-48S24W	18	75	2.37	24	4.13

Default ON/OFF logic is positive.
Add -N to the model number to order negative On/Off logic.
To order RoHS, add (RoHS) to part number.

Features

- 4:1 Input voltage range
- High power density
- Small size 2.4” x 2.28” x 0.55”
- Excellent thermal performance with metal baseplate
- Volt-seconds clamp and fast over voltage protection
- Pulse-by-pulse current limiting, short circuit frequency foldback, dead short shut down
- Over-temperature protection
- Auto-softstart
- Low noise
- Industry-standard pinout
- Constant frequency during normal operation
- Remote sense
- Remote ON/OFF
- Super energy saving, 8 mA input idle current
- Output trim with very low temperature coefficient
- Water washable, wide humidity application
- Good shock and vibration damping
- Available in both RoHS and Non-RoHS construction. See ordering info below model selection chart.

100 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Astrodyne RO
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Unless otherwise stated, these specifications apply for baseplate temperature TB=23±2ºC, nominal input voltage, and rated full load. (1)

Input Parameters

Model		ASD100-24S3.3W	ASD100-24S5W	ASD100-24S12W	ASD100-24S15W	ASD100-24S24W	Units
Voltage Range	MIN TYP MAX	9 24 36					V
Input Overvoltage (100 ms)	MAX	50					V
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	35 4.24	35 4.91	35 4.85	35 4.79	35 4.79	mA A
Inrush Current	MAX	0.5					A^2s
Reflected Ripple, 12μH Source Impedance (3)	TYP	30					mA P-P
Efficiency	TYP	79	85	86	83	87	%
Switching Frequency	TYP	260					kHz
Recommended Fuse		(2)					A

Input Parameters

Model		ASD100-48S3.3W	ASD100-48S5W	ASD100-48S12W	ASD100-48S15W	ASD100-48S24W	Units
Voltage Range	MIN TYP MAX	18 48 75					V
Input Overvoltage (100 mSec)	MAX	80					V
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	25 2.10	25 2.42	25 2.39	25 2.37	25 2.37	mA A
Inrush Current	MAX	0.5					A^2s
Reflected Ripple, 12μH Source Impedance (3)	TYP	30					mA P-P
Efficiency	TYP	81	85	88	88	89	%
Switching Frequency	TYP	260					kHz
Recommended Fuse		(2)					A

* Absolute Maximum Ratings. Caution: Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device (see Note 1.)

100 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Now you have power.

Output Parameters

Model		ASD100-24S3.3W ASD100-48S3.3W	ASD100-24S5W ASD100-48S5W	ASD100-24S12W ASD100-48S12W	ASD100-24S15W ASD100-48S15W	ASD100-24S24W ASD100-48S24W	Units
Output Voltage		3.3	5	12	15	24	V
Output Voltage Setpoint Accuracy	MAX	±1					%
Turn On Overshoot Min-Max Load	TYP	0					%
Temperature Coefficient	TYP MAX	0.005 0.01	0.003 0.005	0.003 0.005	0.003 0.005	0.003 0.005	%/ºC
Noise (8)	TYP TYP	75 20	75 20	150 60	150 60	250 100	mV P-P mV RMS
Load Current (4)	MIN MAX	2.5 25	2 20	0.833 8.33	0.667 6.67	0.413 4.13	A
Load Transient Overshoot (7)	TYP	3					%
Load Transient Recovery Time (6)	TYP	200					μs
Load Regulation (5) Min-Max Load	TYP MAX	0.02 0.2					%
Line Regulation Vin = Min-Max	TYP MAX	0.01 0.1					%
Overvoltage Protection (OVP) Threshhold OVP Type - Non-latching Open Loop Overvoltage Clamp	MIN MAX	115 135					%
Output Current Limit Vout = 90% of Vout-nom	TYP	120					%
Output Short Circuit Current Vout = 0.25V	TYP MAX	140 150					%

Notes:

(1) Refer to the Application Notes for the definition of terms, measurement circuits, and other information.

(2) Refer to the Application Notes for information of fusing. For inrush current, refer to the specifications above.

(3) 33μF capacitor connected between the two "Input" pins. Then insert current sensor in series with 1.0μH inductor between 100μF and the source. The reflected ripple current is measured over a 5 Hz to 20 MHz bandwidth. (current sensor is located between the converter input pin and the 1.0 μH inductor)

(4) Optimum performance is obtained when this power supply is operated within the minimum to maximum load specifications. No damage to the module will occur when the output is operated at less than minimum load, however, below minimum load the dynamic response will degrade. Operation below minimum load is not recommended.

(5) Load regulation is defined as the output voltage change when changing load current from a maximum to minimum.

(6) Load Transient Recovery Time is defined as the time for the output to settle from a 50% to 75% step load change to a 1% error band (rise time of step = 2μs).

(7) Load Transient Overshoot is defined as the peak overshoot during a transient as defined in the Note 6 above.

(8) Noise is measured per the Application Notes. Output noise is measured with a 10μF tantalum capacitor in parallel with a 0.1μF ceramic capacitor connected across the output pins. Measurement bandwidth is 0-20MHz.

(9) When an external ON/OFF switch is used, such as open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 10μA may be sufficient to trigger the ON/OFF to the logic-low state.

(10) Most switches would be suitable for the logic ON/OFF control. In case there is a problem you can make the following estimations and then leave some margin.
When open collector is used for logic high, "Open Circuit Voltage at ON/OFF Pin", "Output Resistance" and "External Leakage Current Allowed for Logic High" are used to estimate the high impedance requirement of open collector.
When switch is used for logic low, "Open Circuit Voltage at ON/OFF Pin", "Output Resistance" and "LOW Logic Level" are used to estimate the low impedance requirement of the switch.

(11) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If converter is mounted horizontally with no obstruction, thermal impedance is approximately 8°C/W.

(12) Water Washability - These DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.

(13) Torque fasteners into threaded mounting inserts at 12 in.lbs. or less. Greater torque may result in damage to unit and void the warranty.

(14) Input impedance on these units needs to be kept to a minimum. The 9-36Vdc DC units need a maximum input impedance of 0.2 Ohms and the 18-75Vdc DC units need a maximum input impedance of 0.8 Ohms. In order to support this requirement, the 9-36Vdc DC units need 25 μF of capacitance (low ESR) for every 1.0 μH of inductance between the power source and the DC/DC converter. The 18-75Vdc DC units need 1.7μF of capacitance (low ESR) for every 1.0 μH of inductance between the power source and the DC/DC converter. Inductance includes all sources and should take into account input power lines.

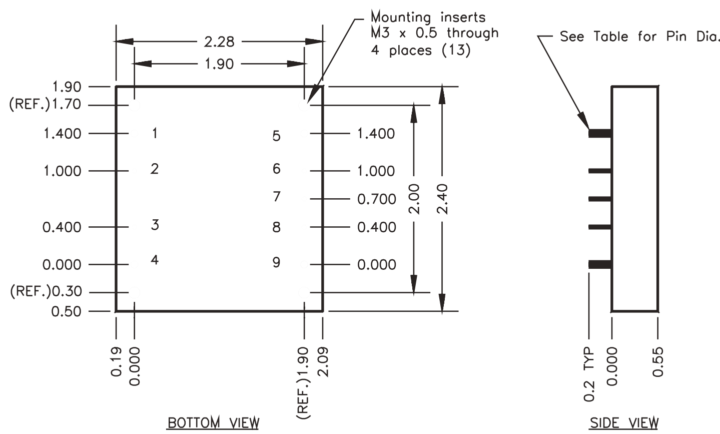
(15) RoHS Compliance:
See Astrodyne Website www.astrodyne.com for the complete RoHS Compliance statement and Application Notes.
The RoHS marking is as follows.

100 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Astrodyne RO
Now you have power.

General Specifications			
All Models			**Units**
ON/OFF Function			
HIGH Logic Level or Leave ON/OFF Pin Open	MIN	3.0	VDC
External Leakage Current Allowed for Logic High (9)	MAX	10	µA
Input Diode Protection Voltage	MAX	50	VDC
LOW Logic Level or Tie ON/OFF Pin to -INPUT	MAX	1.0	VDC
Sinking Current for Logic Low	MAX	500	µA
Open Circuit Voltage at ON/OFF Pin (10) Positive Logic Negative Logic	TYP TYP	2.3 1.5	VDC VDC
Output Resistance	TYP	3	k Ω
Idle Current (Module is OFF)	TYP	8	mADC
Turn-on Time to 1% error	TYP	60	ms
Positive Logic Option	HIGH - Module ON LOW - Module OFF		
Negative Logic Option	HIGH - Module OFF LOW - Module ON		
Output Voltage Remote Sensing			
Maximum Voltage Drops on Leads	MAX	10	%
Line Regulation under remote sensing	TYP MAX	0.02 0.1	%
Load Regulation under remote sensing	TYP MAX	0.05 0.2	%
Output Voltage Trim			
Trim Range	MIN MAX	-10 +10	% of Vout
Input Resistance	TYP	10	kΩ
Open Circuit Voltage	TYP	2.5	V
Trim Limit			
Maximum Output Voltage	MAX	110	% of Vout
Isolation			
Input to Output Isolation 10µA Leakage Vnom = 24V Vnom = 48V	MAX MAX	700 1544	VDC VDC
Input to Output Resistance	MIN	10	MΩ
Input to Output Capacitance	TYP	1600	pF
Environmental			
Calculated MTBF, Bellcore Method 1, Case 1	>1,000,000		h
Baseplate Operating Temperature Range	MIN MAX	-40 100	ºC
Storage Temperature	MIN MAX	-40 120	ºC
Thermal Impedance (11)	TYP	7	ºC/W
Thermal Shutdown Baseplate Temperature (Auto Restart)	MIN TYP	100 110	ºC

General Specifications			
All Models			**Units**
General			
Unit Weight	TYP	4.6/114	oz/g
Case Dimension		2.4" x 2.28" x 0.55"	
Torque on Mounting Inserts	MAX	12 in. lbs.	
Agency Approvals			
UL, TUV		Pending for UL60950 EN60950 (TUV)	
Chassis Mounting Kit		MS21	



TOLERANCE: ALL DIMENSIONS ARE TYPICAL IN INCHES UNLESS OTHERWISE NOTED:	
X.XX	±0.020
X.XXX	±0.005

Pin	Name	Pin Dia.	Pin Dia.
1	-INPUT	0.08"	0.04"
2	CASE	0.04"	0.04"
3	ON/OFF	0.04"	0.04"
4	+INPUT	0.08"	0.04"
5	-OUTPUT	0.08"	0.08"
6	-SENSE	0.04"	0.04"
7	TRIM	0.04"	0.04"
8	+ SENSE	0.04"	0.04"
9	+ OUTPUT	0.08"	0.08"

150 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Astrodyne
Now you have power.

Features

- 4:1 Input voltage range
- High power density
- Small size 2.4” x 2.28” x 0.55”
- Excellent thermal performance with metal baseplate
- Volt-seconds clamp and fast over voltage protection
- Pulse-by-pulse current limiting, short circuit frequency foldback, dead short shut down
- Over-temperature protection
- Auto-softstart
- Low noise
- Industry-standard pinout
- Constant frequency during normal operation
- Remote sense
- Remote ON/OFF
- Super energy saving, 8 mA input idle current
- Output trim with very low temperature coefficient
- Water washable, wide humidity application
- Good shock and vibration damping
- Available in both RoHS and Non-RoHS construction. See ordering info below model selection chart

Description

The 4:1 Input Voltage 150 W single ASD Series of DC/DC converters provide precisely regulated dc outputs. The output voltage is fully isolated from the input, allowing the output to be positive or negative polarity and with various ground connections. The ASD Series utilizes an insulated metal substrate design in an industry standard 1/2 brick case size to meet the most rigorous requirements of COTS and thermally challenging industrial applications.

The 4:1 Input Voltage 150 Watt ASD Series includes remote sensing, output trim, and remote ON/OFF. Threaded-through holes are provided to allow easy mounting or add a heat sink for extended temperature use.

Selection Chart					
Model	Input Range VDC		Iin ADC	Vout VDC	Iout ADC
	Min	Max	TYP		
ASD150-24S3.3W	9	36	5.00	3.3	30
ASD150-24S5W	9	36	7.80	5	30
ASD150-24S12W	9	36	7.18	12	12.5
ASD150-24S15W	9	36	7.10	15	10
ASD150-24S24W	9	36	7.10	24	6.26
ASD150-48S3.3W	18	75	2.45	3.3	30
ASD150-48S5W	18	75	3.60	5	30
ASD150-48S12W	18	75	3.57	12	12.5
ASD150-48S15W	18	75	3.50	15	10
ASD150-48S24W	18	75	3.50	24	6.26

Default ON/OFF logic is positive.
Add -N to the model number to order negative ON/OFF logic.
To order RoHS, add (RoHS) to the part number.

150 WATT ASD SINGLE SERIES DC/DC CONVERTERS

Astrodyne RO
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Unless otherwise stated, these specifications apply for baseplate temperature T_B=23±2ºC, nominal input voltage, and rated full load. (1)

Input Parameters							
Model		**ASD150-24S3.3W**	**ASD150-24S5W**	**ASD150-24S12W**	**ASD150-24S15W**	**ASD150-24S24W**	**Units**
Voltage Range	MIN TYP MAX	9 24 36					V
Input Overvoltage (100 ms)	MAX	50					V
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	35 5.0	35 7.8	35 7.18	35 7.10	35 7.10	mA A
Inrush Current	MAX	0.5					A^2s
Reflected Ripple, 12µH Source Impedance (3)	TYP	30					mA P-P
Efficiency	TYP	78	80	85	86	86	%
Switching Frequency	TYP	260					kHz
Recommended Fuse		(2)					A

Input Parameters							
Model		**ASD150-48S3.3W**	**ASD150-48S5W**	**ASD150-48S12W**	**ASD150-48S15W**	**ASD150-48S24W**	**Units**
Voltage Range	MIN TYP MAX	18 48 75					V
Input Overvoltage (100 ms)	MAX	80					V
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	25 2.45	25 3.60	25 3.57	25 3.50	25 3.50	mA A
Inrush Current	MAX	0.5					A^2s
Reflected Ripple, 12µH Source Impedance (3)	TYP	30					mA P-P
Efficiency	TYP	81	85	88	88	89	%
Switching Frequency	TYP	260					kHz
Recommended Fuse		(2)					A

* Absolute Maximum Ratings. Caution: Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device (see Note 1.)

150 WATT ASD SINGLE SERIES DC/DC CONVERTERS

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Output Parameters							
Model		**ASD150-24S3.3W ASD150-48S3.3W**	**ASD150-24S5W ASD150-48S5W**	**ASD150-24S12W ASD150-48S12W**	**ASD150-24S15W ASD150-48S15W**	**ASD150-24S24W ASD150-48S24W**	**Units**
Output Voltage		3.3	5	12	15	24	V
Output Voltage Setpoint Accuracy	MAX	±1					%
Turn On Overshoot Min-Max Load	TYP	0					%
Temperature Coefficient	TYP MAX	0.005 0.01	0.003 0.005	0.003 0.005	0.003 0.005	0.003 0.005	%/ºC
Noise (8)	TYP TYP	75 20	75 20	150 60	150 60	250 100	mV P-P mV RMS
Load Current (4)	MIN MAX	3 30	3 30	1.25 12.5	1 10	0.626 6.26	A
Load Transient Overshoot (7)	TYP	3					%
Load Transient Recovery Time (6)	TYP	200					µs
Load Regulation (5) Min-Max Load	TYP MAX	0.02 0.2					%
Line Regulation Vin = Min-Max	TYP MAX	0.01 0.1					%
Overvoltage Protection (OVP) Threshhold OVP Type - Non-latching Open Loop Overvoltage Clamp	MIN MAX	115 135					%
Output Current Limit Vout = 90% of Vout-nom	TYP	120					%
Output Short Circuit Current Vout = 0.25V	TYP MAX	140 150					%

Notes:

(1) Refer to the Application Notes for the definition of terms, measurement circuits, and other information.

(2) Refer to the Application Notes for information of fusing. For inrush current, refer to the specifications above.

(3) 100µFcapacitor connected between the two “Input” pins. Then insert current sensor in series with 1.0µH inductor between 100µF and the source. The reflected ripple current is measured over a 5 Hz to 20 MHz bandwidth. (current sensor is located between the converter input pin and the 1.0 µH inductor)

(4) Optimum performance is obtained when this power supply is operated within the minimum to maximum load specifications. No damage to the module will occur when the output is operated at less than minimum load, however, below minimum load the dynamic response will degrade. Operation below minimum load is not recommended.

(5) Load regulation is defined as the output voltage change when changing load current from a maximum to minimum.

(6) Load Transient Recovery Time is defined as the time for the output to settle from a 50% to 75% step load change to a 1% error band (rise time of step = 2µs).

(7) Load Transient Overshoot is defined as the peak overshoot during a transient as defined in the Note 6 above.

(8) Noise is measured per the Application Notes. Output noise is measured with a 10µF tantalum capacitor in parallel with a 0.1µF ceramic capacitor connected across the output pins. Measurement bandwidth is 0-20MHz.

(9) When an external ON/OFF switch is used, such as open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 10µA may be sufficient to trigger the ON/OFF to the logic-low state.

(10) Most switches would be suitable for the logic ON/OFF control. In case there is a problem you can make the following estimations and then leave some margin.
When open collector is used for logic high, “Open Circuit Voltage at ON/OFF Pin”, “Output Resistance” and “External Leakage Current Allowed for Logic High” are used to estimate the high impedance requirement of open collector.
When switch is used for logic low, “Open Circuit Voltage at ON/OFF Pin”, “Output Resistance” and “LOW Logic Level” are used to estimate the low impedance requirement of the switch.

(11) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If converter is mounted horizontally with no obstruction, thermal impedance is approximately 8°C/W.

(12) Water Washability - These DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.

(13) Torque fasteners into threaded mounting inserts at 12 in.lbs. or less. Greater torque may result in damage to unit and void the warranty.

(14) Input impedance on these units needs to be kept to a minimum. The 9-36Vdc DC units need a maximum input impedance of 0.135Ω and the 18-75Vdc DC units need a maximum input impedance of 0.54Ω. In order to support this requirement, the 9-36Vdc DC units need 55 µF of capacitance (low ESR) for every 1.0 µH of inductance between the power source and the DC/DC converter. The 18-75Vdc DC units need 3.5µF of capacitance (low ESR) for every 1.0 µH of inductance between the power source and the DC/DC converter. Inductance includes all sources and should take into account input power lines.

(15) RoHS Compliance:
See Astrodyne Website www.astrodyne.com for the complete RoHS Compliance statement and Application Notes.
The RoHS marking is as follows.

150 WATT ASD SINGLE SERIES DC/DC CONVERTERS

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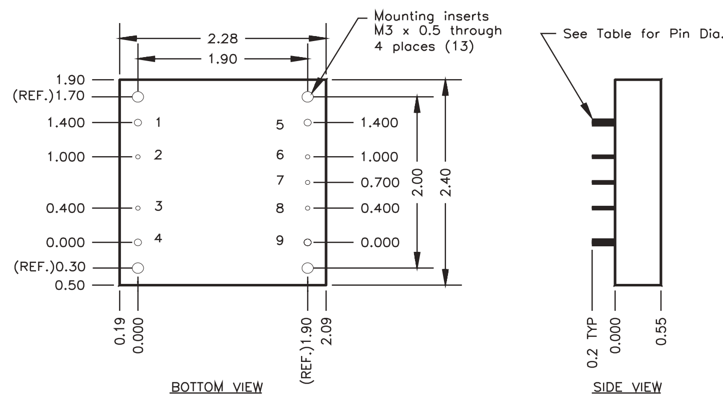
General Specifications			
All Models			**Units**
ON/OFF Function			
HIGH Logic Level or Leave ON/OFF Pin Open	MIN	3.0	VDC
External Leakage Current Allowed for Logic High (9)	MAX	10	µA
Input Diode Protection Voltage	MAX	50	VDC
LOW Logic Level or Tie ON/OFF Pin to -INPUT	MAX	1.0	VDC
Sinking Current for Logic Low	MAX	500	µA
Open Circuit Voltage at ON/OFF Pin (10) Positive Logic Negative Logic	TYP TYP	2.3 1.5	VDC VDC
Output Resistance	TYP	3	k Ω
Idle Current (Module is OFF)	TYP	8	mADC
Turn-on Time to 1% error	TYP	60	ms
Positive Logic Option	HIGH - Module ON LOW - Module OFF		
Negative Logic Option	HIGH - Module OFF LOW - Module ON		
Output Voltage Remote Sensing			
Maximum Voltage Drops on Leads	MAX	10	%
Line Regulation under remote sensing	TYP MAX	0.02 0.1	%
Load Regulation under remote sensing	TYP MAX	0.05 0.2	%
Output Voltage Trim			
Trim Range	MIN MAX	-10 +10	% of Vout
Input Resistance	TYP	10	kΩ
Open Circuit Voltage	TYP	2.5	V
Trim Limit			
Maximum Output Voltage	MAX	110	% of Vout
Isolation			
Input to Output Isolation 10µA Leakage Vnom = 24V Vnom = 48V	MAX MAX	700 1544	VDC VDC
Input to Output Resistance	MIN	10	MΩ
Input to Output Capacitance	TYP	1600	pF

General Specifications			
All Models			**Units**
Environmental			
Calculated MTBF, Bellcore Method 1, Case 1		>1,000,000	h
Baseplate Operating Temperature Range	MIN MAX	-40 100	°C
Storage Temperature	MIN MAX	-40 120	°C
Thermal Impedance (11)	TYP	7	°C/W
Thermal Shutdown Baseplate Temperature (Auto Restart)	MIN TYP	100 110	°C
General			
Unit Weight	TYP	4.6/114	oz/g
Case Dimension		2.4" x 2.28" x 0.55"	
Torque on Mounting Inserts	MAX	12 in. lbs.	
Agency Approvals			
UL		IEC 60950-1, EN60950-1	
Chassis Mounting Kit		MS21	



TOLERANCE: ALL DIMENSIONS ARE TYPICAL IN INCHES UNLESS OTHERWISE NOTED:	
X.XX	±0.020
X.XXX	±0.005

Pin	Name	24Vin Pin Dia.	48Vin Pin Dia.
1	-INPUT	0.08"	0.04"
2	CASE	0.04"	0.04"
3	ON/OFF	0.04"	0.04"
4	+INPUT	0.08"	0.04"
5	-OUTPUT	0.08"	0.08"
6	-SENSE	0.04"	0.04"
7	TRIM	0.04"	0.04"
8	+ SENSE	0.04"	0.04"
9	+ OUTPUT	0.08"	0.08"

240 WATT W SERIES DC/DC CONVERTERS

Features

- 4:1 Input voltage range
- High power density
- Small size 2.4” x 2.28” x 0.55”
- Efficiency up to 90%
- Excellent thermal performance with metal case
- Pulse-by-pulse current limiting
- Over-temperature protection
- Auto-softstart
- Constant frequency
- Remote sense
- Remote ON/OFF
- Ultra-wide output voltage trim
- Water washable, high humidity applications
- Good shock and vibration damping
- Available in both RoHS and non-RoHS construction. See ordering info below.

Description

The 4:1 Input Voltage 240 Watt Single ASD240 DC/DC converter provides a precisely regulated dc output. The output voltage is fully isolated from the input, allowing the output to be positive or negative polarity and with various ground connections. The 240 Watt ASD240 meets the most rigorous performance standards in an industry standard footprint for mobile (12V_{IN}), process control (24V_{IN}) and military COTS (28V_{IN}) applications.

The 4:1 Input Voltage 240 Watt ASD240 includes remote sensing, ultra-wide output voltage trim, and remote ON/OFF. Threaded through holes are provided to allow easy mounting or addition of a heatsink for extended temperature operation.

Model	Input Range VDC		Vout VDC	Iout ADC
	Min	Max		
ASD240-24S12W	9	36	12	20
ASD240-24S15W	9	36	15	16
ASD240-24S24W	9	36	24	10
ASD240-24S28W	9	36	28	8.6
ASD240-24S48W	9	36	48	5

Default Logic is positive.
To order negative logic, add -N to the part number
To order RoHS, add (RoHS) to the part number

240 WATT W SERIES DC/DC CONVERTERS

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Input Parameters							
Model		**ASD240-24S12W**	**ASD240-24S15W**	**ASD240-24S24W**	**ASD240-24S28W**	**ASD240-24S48W**	**Units**
Voltage Range	MIN TYP MAX	9.0 24.0 36.0					V
Input Overvoltage (100 ms)	MAX	40					V
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout	TYP	Start-up: 8.5 / Shut-down: 8.0					V
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	325 12.5	325 TBD				mA A
Inrush Current	MAX	0.5					A^2s
Reflected Ripple	TYP	50					mA P-P
Switching Frequency	TYP	210					kHz
Recommended Fuse		(2)					A
External Input Capacitance	MIN	470					µF

Output Parameters							
Model		**ASD240-24S12W**	**ASD240-24S15W**	**ASD240-24S24W**	**ASD240-24S28W**	**ASD240-24S48W**	**Units**
Output Voltage		12	15	24	28	48	V
Output Voltage Setpoint Accuracy	MAX	±1					%
Turn On Overshoot	TYP	2.5					%
Temperature Coefficient (5)	TYP MAX	0.015 0.03					%/ºC
Noise (3)	TYP TYP	120 40	150 50	240 80	280 100	480 150	mV P-P mV RMS
Load Current	MIN MAX	0 20	0 16	0 10	0 8.6	0 5	A
Load Transient Overshoot (4)	TYP	4					%
Load Transient Recovery Time (4)	TYP	600					µs
Load Regulation (7) Min-Max Load	TYP MAX	0.05 0.2					%
Line Regulation Vin = Min-Max	TYP MAX	0.03 0.1					%
Overvoltage Protection (OVP) Threshold OVP Type - Non-latching Open Loop Overvoltage Clamp	TYP	115					%
Output Current Limit Vout = 90% of Vout-nom	TYP	105					%
External Output Capacitance	MIN	100					µF

240 WATT W SERIES DC/DC CONVERTERS

General Specifications			
All Models			**Units**
ON/OFF Function			
Converter - ON HIGH Logic Level / Leave ON/OFF Pin Open (13)	MIN	3.0	V
External Leakage Current Allowed for Logic High (8)	MAX	10	μA
Converter - OFF LOW Logic Level / Tie ON/OFF Pin to -INPUT (13)	MAX	1.0	V
Sinking Current for Logic Low	MAX	500	μA
Idle Current (Module is OFF)	TYP	40	mA
Turn-on Time to 1% error	TYP	180	ms
Output Voltage Remote Sensing			
Maximum Voltage Drops on Leads	MAX	10	%
Line Regulation under remote sensing	TYP MAX	0.02 0.1	%
Load Regulation under remote sensing	TYP MAX	0.05 0.2	%
Output Voltage Trim			
Trim Range	MIN MAX	-25 +10	% of Vout
Input Resistance	TYP	10	kΩ
Open Circuit Voltage	TYP	2.5	V
Trim Limit			
Maximum Output Voltage	TYP	110	% of Vout
Isolation			
Input to Output Isolation 10μA Leakage	MAX	1544	VDC
Input to Output Resistance	MIN	10	MΩ
Input to Output Capacitance	TYP	2200	pF
Environmental			
MTBF MIL-HDBK-217 (14)	TBD		h
MTBF Bellcore Method 1, Case 1	TBD		h
Case Operating Temperature Range	MIN MAX	-40 100	ºC
Storage Temperature	MIN MAX	-40 120	ºC
Thermal Impedance (9)	TYP	7	ºC/W
Thermal Shutdown Case Temperature (Auto Restart)	TYP	105	ºC
General			
Efficiency		See Graph page 5	
Unit Weight		135	g
Case Dimension		2.4" x 2.28" x 0.55"	
Designed to meet UL/cUL 60950, IEC/EN 60950-1			

Now you have power.

Notes:

(1) All parameters measured at T_C=+25ºC ambient, Vin = Vnom, maximum rated load, unless otherwise noted.

(2) External fusing should be used for system protection in the event of a catastrophic failure.

(3) Output noise is measured with a 10μF ceramic capacitor and a 1μF ceramic capacitor connected across the output pins. The fundamental component of noise is at the switching frequency. Using smaller value capacitors will make the output noise slightly higher. Bandwidth limit is 20 MHz.

(4) Load Transient Overshoot is the output voltage peak amplitude, referenced to the final value, due to a step load change from 50% of maximum load to 75% of maximum load. "Load Transient Overshoot" and "Dynamic Response" are the same specification. Load Transient Recovery Time is the time it takes the output to return to the specified voltage error band centered around the final value. Transient response may degrade at low load currents.

(5) Temperature coefficient is defined for case temperatures. Output voltage deviation is calculated as the maximum resulting from either 1) 25ºC case to maximum operating case temperature, or 2) 25ºC case to minimum operating case temperature.

(6) Test with resistor load of 20mΩ maximum connected across the output pins.

(7) Load regulation is defined as the output voltage change resulting from a load current change from minimum to maximum. The voltage is measured at the output pins.

(8) When an external ON/OFF switch is used, such as an open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 10μA may be sufficient to trigger the ON/OFF to the logic-low state.

(9) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If the converter is mounted horizontally with no obstructions, thermal impedance is approximately 8ºC/W.

(10) Water washability - These DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.

(11) Torque fasteners into threaded mounting inserts at 10 in. lbs. or less. Greater torque may result in damage to unit and void the warranty.

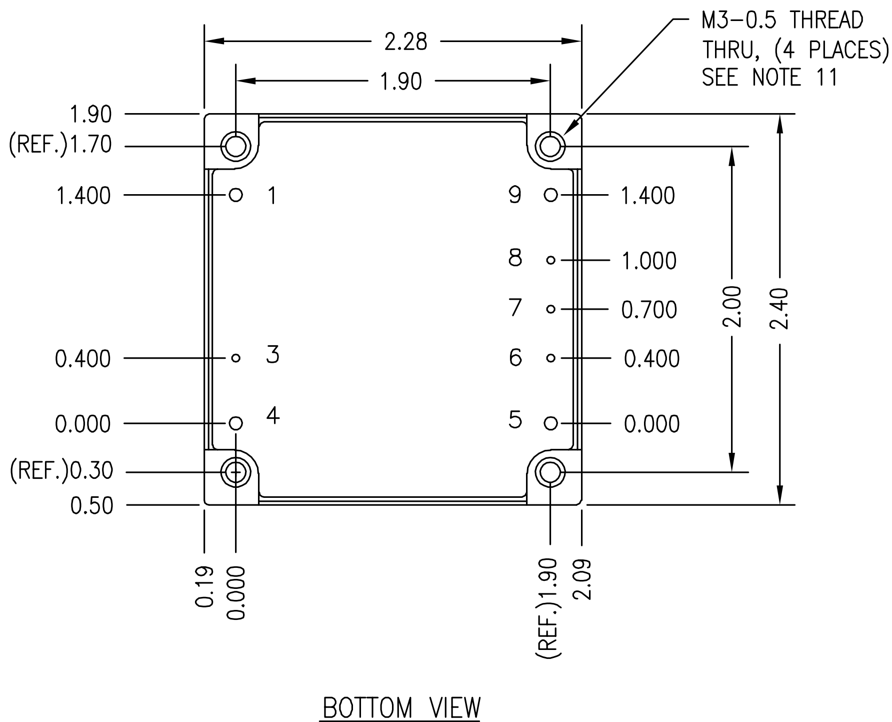
(12) The input impedance on these units must be kept to a maximum of 100mΩ. In order to support this requirement, this converter needs 55μF of capacitance (low ESR) for every 1.0μH of inductance between the power source and the DC/DC converter.

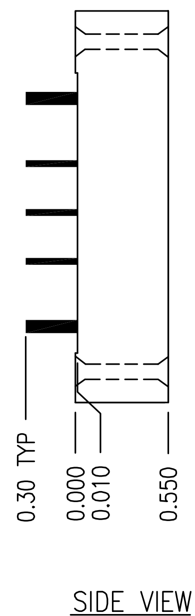
(13) The range between 1V as maximum turn off voltage and 3V as minimum turn on voltage is considered the dead-band. Operation in the dead-band is not recommended.

(14) MTBF is calculated based on MIL-HDBK-217F under the following conditions:
Reliability prediction method = Part Stress Analysis
Baseplate temperature = 40ºC
Environment = Ground, Benign

(15) Specifications subject to change without notice.

(16) RoHS Compliance:
See Astrodyne Website (www.astrodyne.com) for the complete RoHS Compliance statement.
The RoHS marking is as follows.





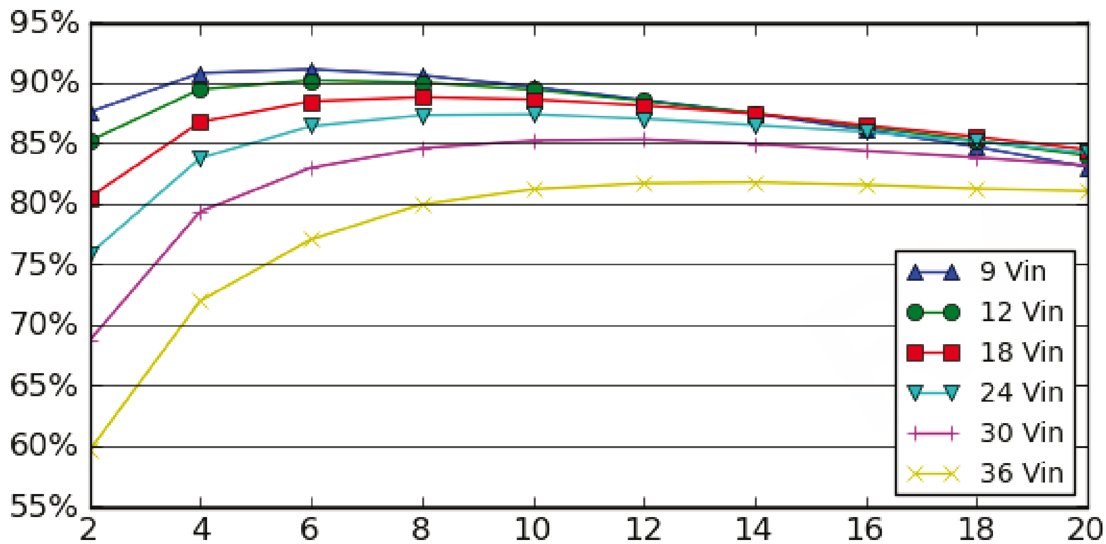
Pin	Name	Pin Dia. (Typ.)
1	-INPUT	0.08”
3	ON/OFF	0.04”
4	+INPUT	0.08”
5	+OUTPUT	0.08”
6	+SENSE	0.04”
7	TRIM	0.04”
8	- SENSE	0.04”
9	- OUTPUT	0.08”

TOLERANCE: ALL DIMENSIONS ARE TYPICAL IN INCHES UNLESS OTHERWISE NOTED:	
X.XX	±0.02
X.XXX	±0.005

Efficiency Curves

Typical values at +25ºC ± 3ºC case temperature.

ASD240-24S12W (12V Output):



Efficiency as a function of load current for various input voltages

SV24 SUPERVERTER® 300-400 SERIES

300-400 WATTS 24VDC INPUT 1/2 BRICK INDUSTRY STANDARD

DESCRIPTION

The SuperVerter 24 Series are high power density and high dynamic response DC-DC converters designed for use in telecom, wireless, and other centralized modular or distributed power systems using 24V input. The SuperVerter 24 family of DC-DC converters may be used as form, fit, function replacements for the industry standard half bricks.

FEATURES

- Direct Replacement for Industry Standard
- High Efficiency
- High MTBF (1.8 million hours)
- Constant Frequency
- Clamp Over Voltage Protection
- Remote Sense
- Trim Range: 60% to 110%
- Encapsulated
- High Power Density
- Low Noise
- -40° to +100° C Baseplate Operation
- Choice of On/Off Logic
- Safety Agency Approved
- Threaded or Thru Mounting Holes
- Optional Pin lengths
- Over Temperature Protection

OPTIONAL FEATURES

For the optional features listed below, simply list the appropriate digit(s) for the features you want in ascending order in the suffix following -175 to -400 in the part number

Feature Options	Suffix
Negative Logic On/Off is standard	include "1" in the suffix
Positive Logic On/Off is optional	delete "1" from the suffix
Threaded mounting holes, as shown in the outline drawing are standard	no suffix digit required
Optional thru mounting holes (without threads) of 0.130" inside diameter*	include "4" in the suffix
Pin length of 0.20" (5.1mm) is standard	no suffix digit required
Pin length of 0.145" (3.68mm)*	include "6" in the suffix
Pin length of 0.110" (2.79mm)*	include "8" in the suffix

** Minimum order quantities apply.*

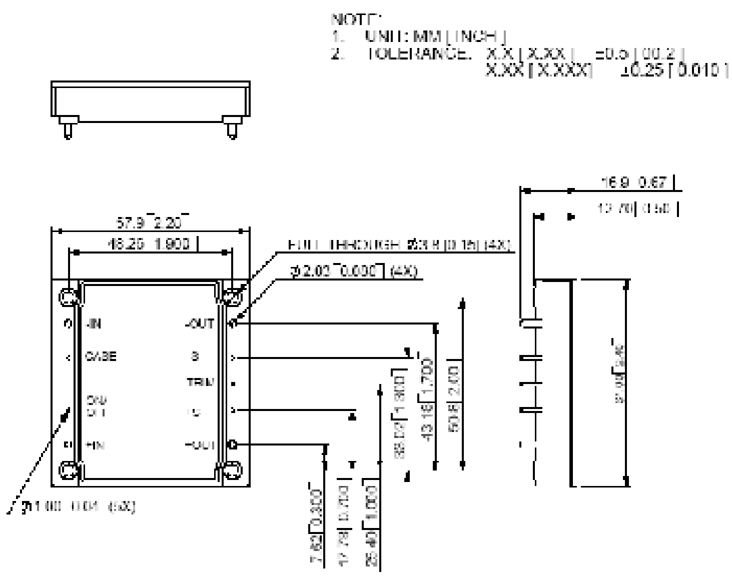
Examples:

SV24-5-175-1 Standard module negative logic, threaded inserts, 0.20 inch pins.
SV24-5-175-48 Positive logic, through hole inserts, 0.110 inch pins.
SV24-5-175-146 Negative logic, through hole inserts, 0.145 inch pins.

MODEL SELECTION

Model	Output Voltage	Output Current
24 VDC (18-36V)		
SV24-12-300-1	12V	25 A
SV24-24-300-1	24V	12.5A
SV24-28-350-1	28V	12.5A
SV24-32-400-1	32V	12.5A

OUTLINE DRAWING:



MV380 MEGAVERTER® SERIES

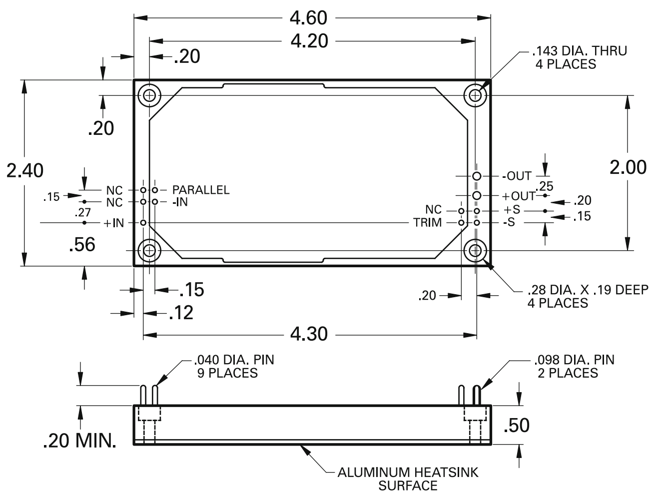
500-600 WATTS   380VDC INPUT   FULL BRICK   HIGH POWER

DESCRIPTION

MegaVerter 380 DC-DC converters are high density, high power modules packaged in the industry standard full brick size (2.4 x 4.6 x 0.5 in) for circuit board mounting. They are primarily used in conjunction with PFC modules to create AC-DC high power, low profile front ends.

FEATURES

- High Efficiency: 88-91%
- Constant Frequency
- -40 to +100°C Operation
- Remote Sense
- Wide Trim Range
- Encapsulated
- Non-Shutdown Over Voltage Protection
- High Power Density: 109 W/cu. in.
- Low Noise
- 105°C Over Temperature Protection
- Safety Agency Compliant
- Parallelable with Current Sharing for n+m Redundancy



MODEL SELECTION

Input	Output Voltage	Output Current
380 VDC		
(360-400V)		
MV380-26	26V	20.0A
MV24-28-600	28V	21.5A
MV380-28-700	28V	25A

MV380 MEGAVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Units	Conditions
Absolute Maximum Ratings: Exceeding absolute maximum ratings may cause permanent damage or reduce reliability.						
PARAMETER	Input Voltage (+In to –In)	-0.3		420	Vdc	
	Enable Voltage (Enable to –In)	-0.3		6.0	Vdc	
	Parallel Pin Voltage (ref to –In)	-0.3		5.0	Vdc	
	Storage Temperature	-55		+125	°C	
	Operating Temperature	-40		+100	°C	Baseplate
	Soldering Temperature (Wave Solder)			260	°C	< 5 sec.
	Soldering Temperature (Hand Solder)			390	°C	< 7 sec.
Electrical Specifications: Apply over the entire range of input voltage, output current, and temperature unless indicated.						
INPUT	Input Voltage	360	380	400	Vdc	
	Maximum Input Current			2.5	A	
	Input Ripple Rejection		60		dB	@120Hz

MV380 MEGAVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Units	Conditions
OUTPUT	Voltage Set Point					
	MV380-26	25.75	26.0	26.25	Vdc	380V_{in}, 25°C, Full Load
	Load Regulation		0.3	0.6	%	0 to Full load
	Line Regulation		0.02	0.2	%	Over V_{in} Range
	Voltage Drift w/Temperature			0.02	%/°C	-40 to +100°C
	Ripple		1	2	%V p-p	5Hz to 20MHz
	Rated Current					
	MV380-26	0		20.0	A	
	Output Power					
	MV380-26			520	W	
	Current Limit Inception	115	120	130	% F.L.	V_{out} = 95% V_{out} nominal
	Short Circuit Current			150	% F.L.	V_{out} = 250 mV,
	Transient Response Peak Deviation (1.0A/µsec slew rate)					
	MV380-26		5		% V_{out}	25% to 75% Load Change
	Transient Response Settling Time (1.0A/µsec slew rate)		100		µsec	V_{out} within 1% V_{out} nominal
	Efficiency	*See Curves on Page 56*				
	MV380-26		88		%	V_{in}= 380V, Full Load, 70°C Case,
	External Load Capacitance					
	MV380-26	0		3,300	uF	
ISOLATION	Input/Output Isolation			4500	Vdc	
	Sense/Output Isolation			500	Vdc	
	Input/Base Plate Isolation			2500	Vdc	
	Output/Base Plate Isolation			500	Vdc	
	Sense/Base Plate Isolation			500	Vdc	
	Input to Output Capacitance		4300		pF	Case Floating
	Input to Output Resistance	10			M ohms	
MECHANICAL	Weight	230(7.4)			g(oz.)	
	Size	0.5 x 2.4 x 4.6			Inches	*See Outline Drawing*
	Thermal Resistance, Case to Ambient (Radiation plus natural convection)	3.3			°C/W	Case Temperature = 100°C
FEATURE	Power Sharing Accuracy			±5	%F.L.	10 to 100% Full Load (F.L.)
	Trim Range					
	MV380-26	18**		30	Vdc	**200 mA minimum load
	Remote Sense Compensation			0.5	Vdc	
	Over Voltage Protection (Non-Shutdown, Auto. Recovery)					
	MV380-26	30		36	Vdc	25° C Case Temperature
	Over Temperature Shut-down	+100	+105	+110	°C	Case Temperature
	Turn-On Time		600		msec	F.L., V_{out} within 1% V_{out} Nominal
	Enable*					
	Logic Off Threshold	0.8			V	V_{out} = 0
	Enable Current (Logic Off)			1.0	mA	@ V_{enable} = 0V
	Logic On Threshold			2.4	V	
	Logic Turn-On Time			2	msec	F.L., V_{out} within 1% V_{out} Nominal

**An open collector connection or equivalent is recommended for on/off control*

Now you have power.

High Output Power, High Efficiency DC/DC Converter

MV24-28-600S

- Industry Standard 4.59" x 2.4" x 0.5" Package
- High Power Density up to 109.29W/ Inch ³
- High Typical Efficiency of 91%
- Low Output Noise
- Metal Baseplate
- Thermal Protection
- Over Voltage and Over Current Protection
- Output Under Voltage Protection
- Adjustable Output Voltage
- Remote Sense
- Auxiliary Voltage of 8V, +/-1V
- I.O.G (DC Good): Open Collector Output
- Remote ON/OFF Control

DESCRIPTION:
The MEGAVERTER® MV24-28-600S dc/dc converter is a high density, feature rich module packaged in the industry standard "full brick" size (2.4 x 4.59 x 0.5 inches) for circuit board mounting. It is designed for use in a 24/28 Vdc (18-36Vdc) input applications where large blocks of DC power are required. The MV24-28-600S utilizes an insulated metal substrate and is therefore well suited for the most rigorous requirements of COTS and thermally challenging industrial applications.

Model Number	Output Voltage	Output Amps	Input Range	Max. Iin FL	Efficiency	Max Output Power
MV24-28-600S	28 VDC	21.5	18-36 VDC	28.9A	91%	600 Watts

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Now you have power.

High Output Power, High Efficiency DC/DC Converter

MV24-28-600S

ABSOLUTE MAXIMUM RATINGS (MIN TO MAX.)

Input Voltage (+In to -In)	-0.3 to 50VDC (<100mS)
	-0.3 to 36VDC (Continuous)
Storage Temperature	-55 to +125°C
Storage Humidity	10 to 95%
Operating Temperature	-40 to 100°C
	Temperature measurement shall be
	taken from the baseplate (Tb). See
	Fig. 3 for location definition
Operating Humidity	30 to 95%

INPUT SPECIFICATIONS

Input Operation Voltage:	18-36 VDC
Input Current FL	28.9A max. @ 24Vin, Full Load (FL)
Inrush Transient	$2A^2s$
Input Ripple Rejection	60dB@120Hz

OUTPUT SPECIFICATIONS

Output Voltage	28VDC
Output Current (Io, max.)	21.5A (Note 1)
Output Set Point (Vo,set)	27.95-28.05V @ Tb=25°C,
	24Vin, FL
Output Voltage Accuracy	27.72-28.28 @ 24Vin, FL
Load Regulation (0% to FL)	+/-0.2%, max.
Line Regulation (HL-LL)	+/-0.2%, max.
Temperature Coefficient	+/-0.02%/°C, -40 to 100°C
Ripple/Noise	250mV p-p max. (Note 2)
Dynamic Response:	
Peak Deviation	3%Vo, set (Note 4)
Settling Time	300uS
Over Voltage Protection	115-135% of Output, Io=0.5A
Output Under Voltage Protection	12V, Output Overload & Short Circuit
Over Temperature Protection	105-115°C, Auto Recover @ 100°C
Current Limit	105-140% of Rated Load (Note 3)
Efficiency	91% @ 24Vin, 28Vo, 80%L
	Tb=25°C

ISOLATION SPECIFICATIONS

Input-Output, Input-Case	1500VDC, 60S
Output-Case	500VDC, 60S
Input-Output Capacitance	2000pF
Isolation Resistance	100MΩ @ Tb=25°C & 70%RH
	Output to Baseplate-500VDC

STRUCTURAL DYNAMICS

Vibration	(Note 5)
Shock	20g, 166in/sec, Square Wave

GENERAL SPECIFICATIONS

MTBF	1.2Mhrs Tb=40°C, 80%FL, 24Vin
Weight	7.94 oz (225g)
Dimensions	4.59” x 2.4” x 0.5”
	(116.59 x 60.96 x 12.7mm)

CONTROL SPECIFICATIONS

Turn-On Time	200mS @ 80%FL, max. Vo with
	± 1%Vo set
Trim Adjustment Range	60-100% with Cap, 440uF/35V
	Tb=25°C See **TRIM CIRCUITS**
	Figs 1 & 2

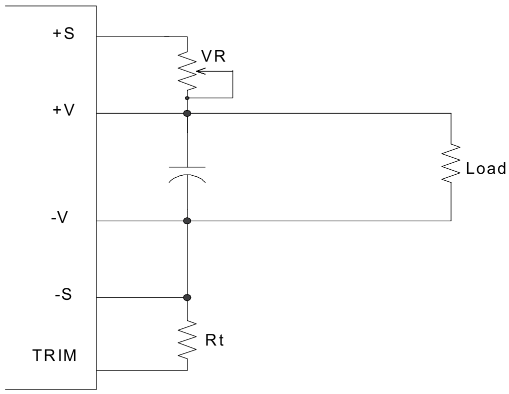
NOTES

1.At Vo = 28V. If Vo > 28V, Output Power (Po) should be ≤ 602W
2.Bandwidth 5Hz to 20MHz and with filter 0.1uF MLCC series 100Ω min.
Output Capacitor: 220uF*2, Tc≥20°C, 220uF*4, Tc≤-20°C.
3. Current Limit inception point Vo=90% of Vo, set @ Tb=25°C.
4. 25%-50%-75% load, 0.1A/uS; With Cap. 440uF/35V Tb=25°C, 24Vin
5. Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm
Constant (Max. 0.5g) X, Y. Z 1 Hour each, at No Operation

All specifications are typical at nominal input, full load, and 25DegC unless otherwise noted

TRIM CIRCUIT:

A. Output Voltage Adjusted by using an external resistor and/or variable resistor:



The output voltage can be determined by below equations:

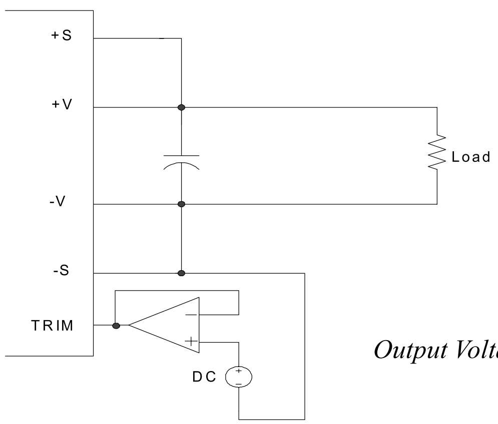
$$V_f = \frac{1.225 * (R_t // 32\ 4))}{7.32 + (Rt // 32.4)} \quad \text{(V)}$$

$$V_{out} = (28 + VR) * V_f \quad \text{(V)}$$

Rt: +/-5% tolerance
VR: +/-20% tolerance
Unit: KΩ

Fig. 1 Schematic of output voltage adjusted by using an external resistor and/or variable resistor.

B. Output Voltage Adjustment by Using an External DC Voltage:



*Output Voltage = TRIM Terminal Voltage * Nominal Output Voltage* (V)

Fig. 2 Schematic of output voltage adjusted by using an external DC voltage.

BASEPLATE MEASURE POINT:

UNIT: mm

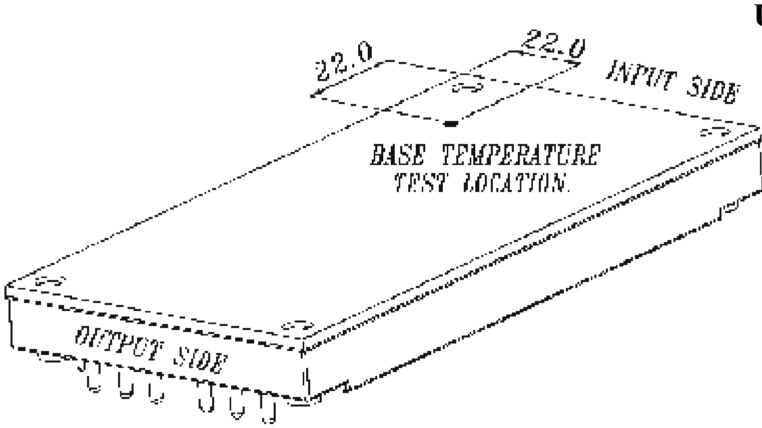
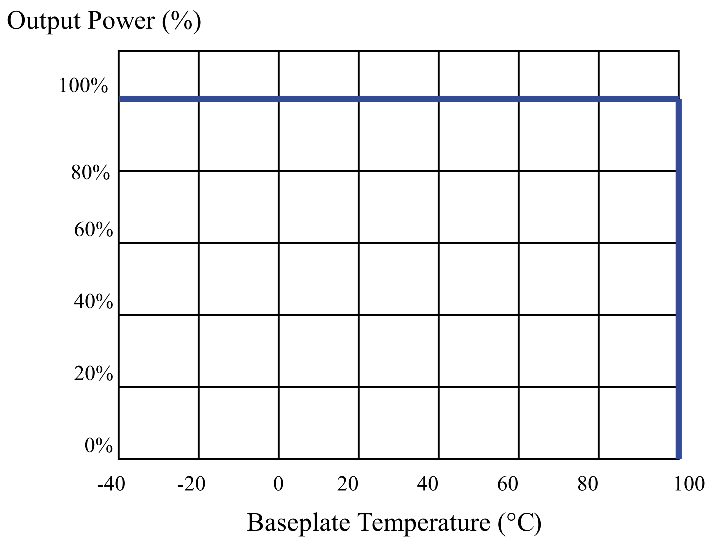
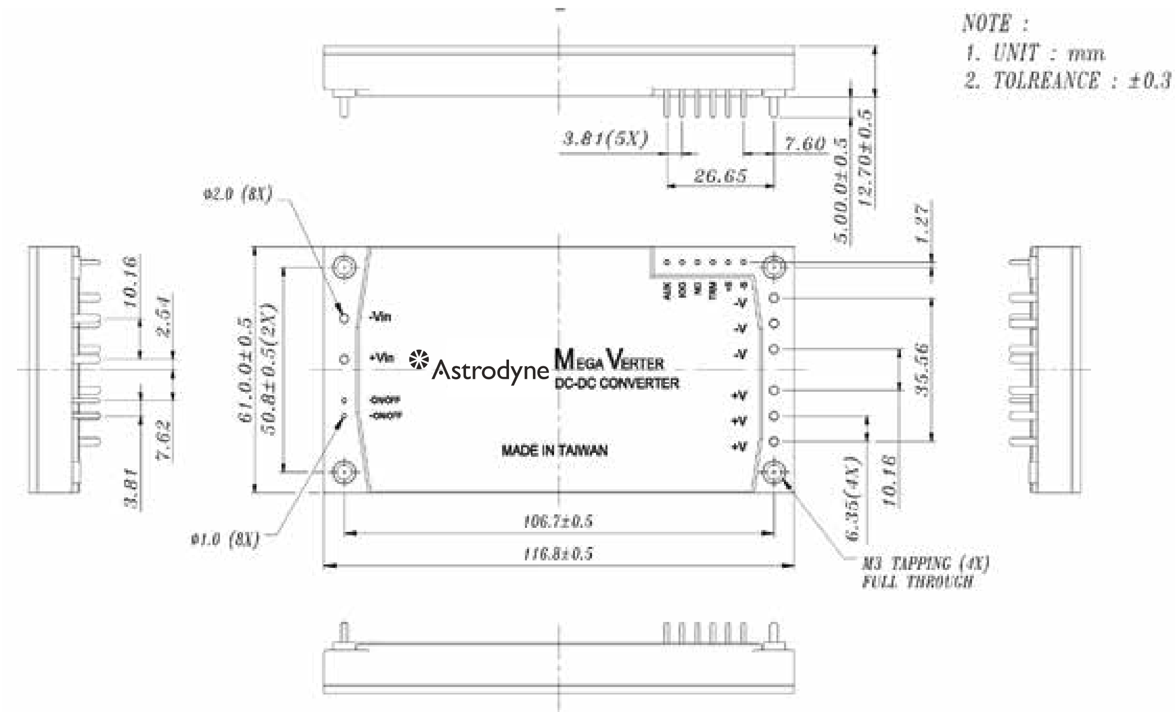


Fig. 3 Baseplate Temperature Measurement Point.

DERATING CURVE:



OUTLINE DRAWING:



Astrodyne
Now you have power.

High Output Power, High Efficiency DC/DC Converter

MV48-28-700LF

- Industry Standard 4.59” x 2.4” x 0.5” Package
- High Power Density up to 127W/ Inch ^{3}
- High Typical Efficiency of 92%
- Low Output Noise
- Metal Baseplate
- Thermal Protection
- Over Voltage Protection
- Current Limit/Short Circuit Protection
- Adjustable Output Voltage: 60% to 115% of Vo, set
- Remote Sense
- Independent Auxiliary Power of 7-10V, Io≤20mA
- I.O.G (DC Good): Open Collector Output
- Remote ON/OFF Control: Short-On, Open-Off

DESCRIPTION:
The MV48-28-700LF module is a high density DC-DC converter designed for use in distributed power architectures. The surface-mount construction uses a metal baseplate and planar transformers to produce up to 700W in a full brick package and is therefore well suited for the most rigorous requirements of COTS and thermally challenging industrial applications.

Model Number	Output Voltage	Output Amps	Input Range	Max. Iin FL	Efficiency	Max Output Power
MV48-28-700LF	28 VDC	25	36-76 VDC	16.4A	92%	700 Watts

Astrodyne
Now you have power.

High Output Power, High Efficiency DC/DC Converter

MV48-28-700LF

ABSOLUTE MAXIMUM RATINGS (MIN TO MAX.)

Input Voltage (+In to -In)	-0.3 to 80VDC (<100mS)
	-0.3 to 76VDC (Continuous)
Storage Temperature	-55 to +125°C
Storage Humidity	10 to 95%
Operating Temperature	-40 to 100°C
	Temperature measurement shall be
	taken from the baseplate (Tb). See
	Fig. 5 for location definition
Operating Humidity	30 to 95%

INPUT SPECIFICATIONS

Input Operation Voltage:	36-76 VDC
Input Current FL	16.4A max. @ 48Vin, FL, Tb=25°C
Inrush Transient	$2A^2s$
Input Ripple Rejection	60dB@120Hz

OUTPUT SPECIFICATIONS

Output Voltage	28VDC
Output Current (Io, max.)	25A (Note 1)
Output Set Point (Vo,set)	27.95-28.05V @ Tb=25°C,
	48Vin, FL
Output Voltage Accuracy	27.72-28.28 @ 48Vin, FL
Load Regulation (0% to FL)	+/-0.2%, max.
Line Regulation (HL-LL)	+/-0.2%, max.
Temperature Coefficient	+/-0.02%/°C max., -40 to 100°C
Ripple/Noise	280mV p-p max. (Note 2)
Dynamic Response: (Note 4)	
Peak Deviation	3%Vo, set
Settling Time	300uS
Over Voltage Protection	115-140% of Output, Io=0.5A
Over Temperature Protection	100-115°C, Auto Recover @ 90°C
Current Limit	105-140% of Rated Load (Note 3)
Short Circuit Current (Note 6)	310%
Efficiency	92% @ 48Vin, 28Vo, 80%L
	Tb=25°C

All specifications are typical at nominal input, full load, and 25DegC unless otherwise noted

ISOLATION SPECIFICATIONS

Input-Output, Input-Case	1500VDC, 60S
Output-Case	500VDC, 60S
Input-Output Capacitance	2000pF
Isolation Resistance	100MΩ @ Tb=25°C & 70%RH
	Output to Baseplate-500VDC

STRUCTURAL DYNAMICS

Vibration	(Note 5)
Shock	20g, 166in/sec, Square Wave

GENERAL SPECIFICATIONS

MTBF	1.2Mhrs Tb=40°C, 80%FL, 48Vin
Weight	7.94 oz (225g)
Dimensions	4.59" x 2.4" x 0.5"
	(116.59 x 60.96 x 12.7mm)

CONTROL SPECIFICATIONS

Turn-On Time	200mS @ 80%FL, max. Vo with
	± 1%Vo set
Trim Adjustment Range	60-110% with Cap, 220uF/35V
	Tb=25°C See **TRIM CIRCUITS**
	Figs 2, 3 & 4
Under Voltage Turn On	22.8-24.8V, Io = 0.5A
Under Voltage Turn Off	20-22V, Io = 0.5A
Hystersis	2V min., 2.8V max.

NOTES

1.At Vo = 28V. If Vo > 28V, Output Power (Po) should be < 700W
2.Bandwidth 5Hz to 100MHz and with filter 0.1uF MLCC series 100Ω min. Output Capacitor: 220uF*2, Tc≥20°C, 220uF*4, Tc≤-20°C.
3. Current Limit inception point Vo=90% of Vo, set @ Tb=25°C.
4. 25%-50%-75% load, 0.1A/uS; With Cap. 220uF/35V Tb=25°C, 48Vin
5. Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm Constant (Max. 0.5g) X, Y. Z 1 Hour each, at No Operation
6. Current limit inception point Vo=250mV

OUTPUT VOLTAGE ADJUSTMENT RANGE

The output voltage can be programmed by appyling an external voltage or external resistor at the TRIM pin. The possible range of values is defined in figure 1. Take note that increasing the output voltage decreases the input voltage range.The OVP will be triggered if the output voltage range exceeds the range defined below. Also, to limit the output power of the module to within specifications, increasing the output voltage needs a corresponding de-rating of the output current.

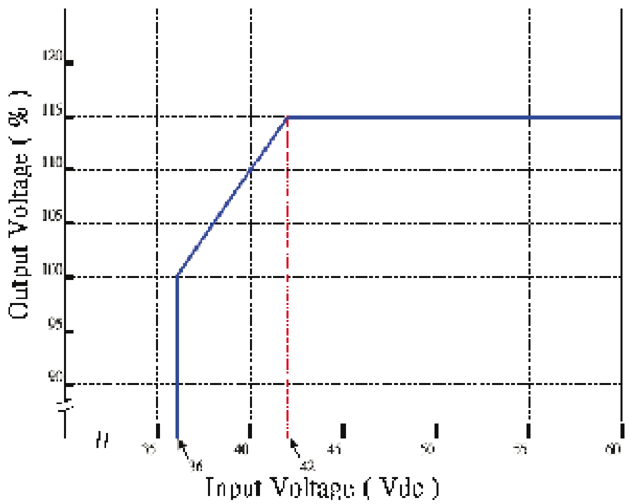
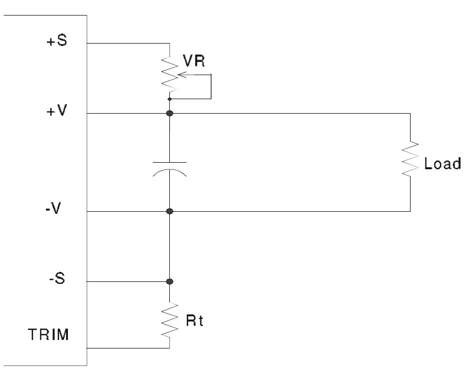


Fig. 1 Limit of Input Voltage.

A. Output Voltage Adjusted by using external resistor and/or variable resistor:



The output voltage can be determined by below equations:

$$V_f = \frac{1.225 * (R_t // 32.4))}{7.32 + (Rt // 32.4)} \quad (V)$$

$$V_{out} = (28 + VR) * V_f \quad (V)$$

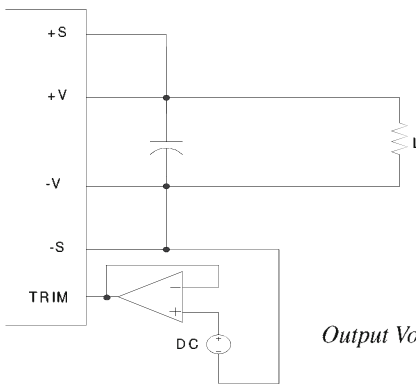
Rt: +/-5% tolerance
VR: +/-20% tolerance
Unit: K ohm

Rt:43K ohm and VR:10K ohm for output +/-10% Variable.

Fig. 2 The schematic of output voltage adjusted by using external resistor and/or variable resistor.

B. Output Voltage Adjustment by Applying External Dc Voltage

The output voltage can be adjusted either by applying an external voltage or external resistor at the trim terminal. The relationship between the trim voltage and output voltage is shown in figure 3.



*Output Voltage = TRIM Terminal Voltage * Nominal Output Voltage* (V)

Fig. 3 The schematic of output voltage adjusted by using external DC voltage.

For all other applications not defined above, the trim circuit of figure 4 may be used.

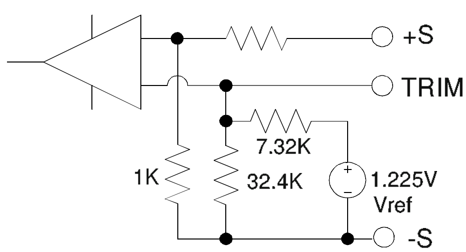
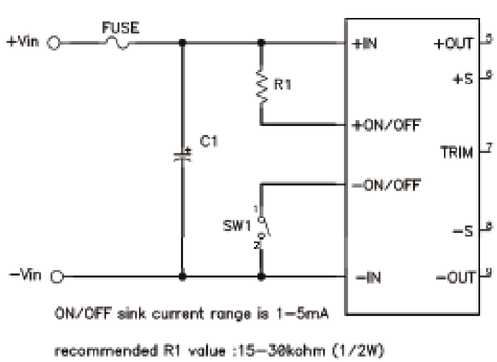


Fig. 4 Trim Circuit (for the reference)

Recommended ON/OFF control Circuit :



SW1 status	Output status
Open	Off
Short	On

Fig. 5 ON/OFF Control Circuit

BASEPLATE MEASURE POINT:

UNIT: mm

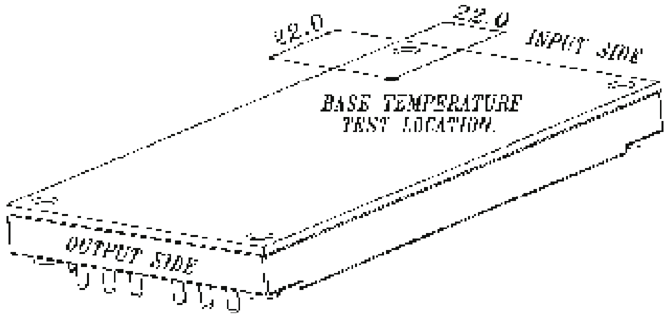
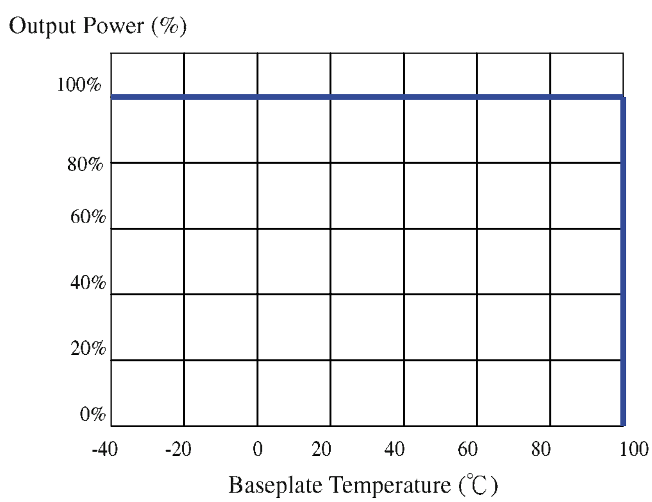
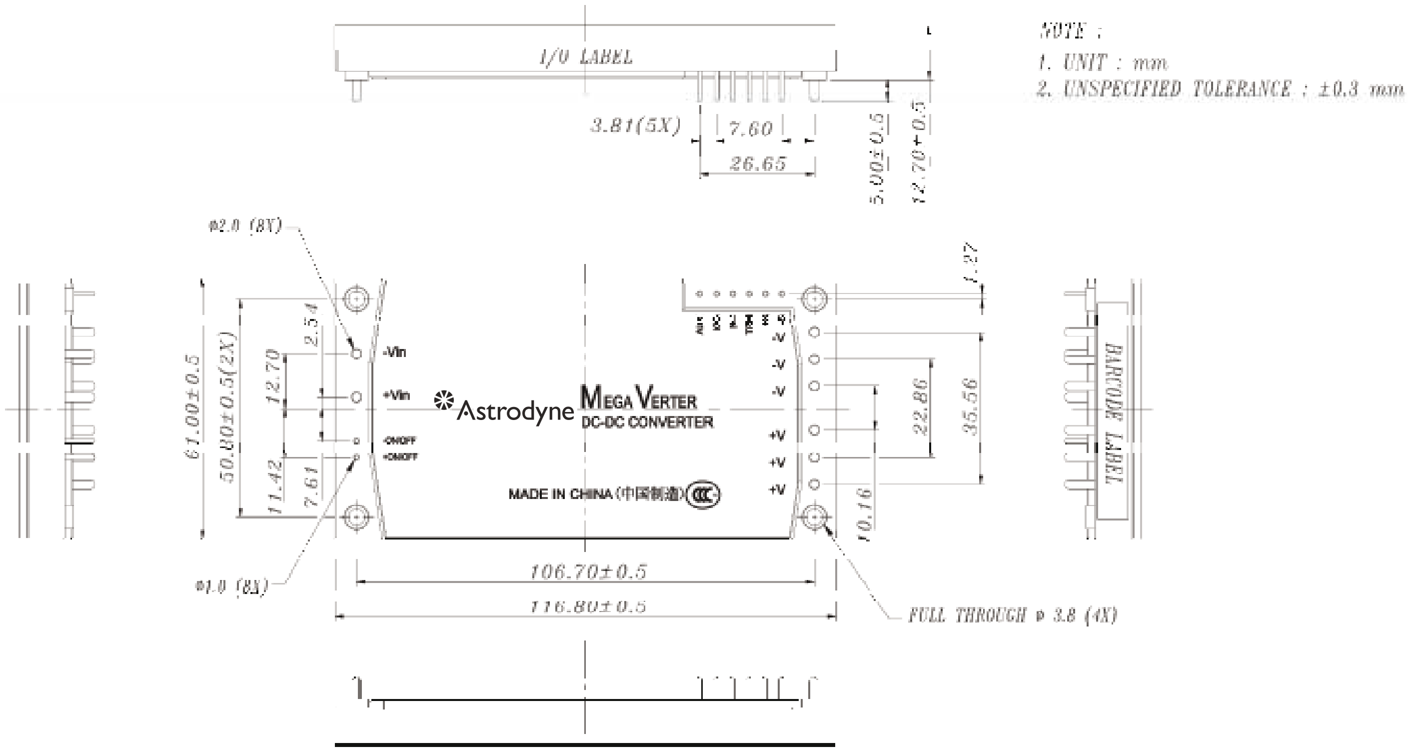


Fig. 6 Baseplate Temperature Measure Point.

DERATING CURVE (for MV48-28-700 only):



OUTLINE DRAWING:



UV300 MICROVERTER® SERIES

126-252 WATTS   300VDC INPUT   3/4 BRICK SINGLES   FULL BRICK TRIPLES

DESCRIPTION

The µV300 Series are high density DC-DC converters designed for use in telecom and other centralized modular and distributed power applications. The µV300 Series use metal PC boards, planar transformers, and surface mount construction to produce up to 252 watts in a tiny package.

FEATURES

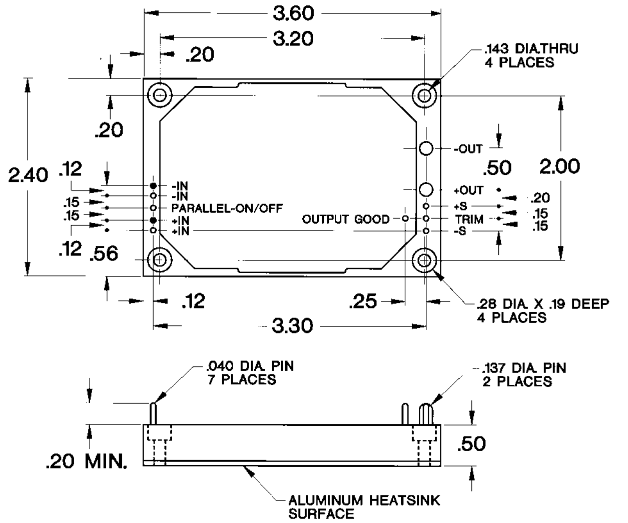
- Miniature Size
- High Density – Up to 58 W/in.3
- Constant Frequency – 370KHZ
- Parallelable with Current Sharing
- Fault Tolerant – n+m Redundancy
- Extremely Low Thermal Resistance
- Output Good Signal
- Optional Sync Pin
- Non-Shutdown OVP
- Logic On-Off
- Thermal Protection
- Current Limit/Short Circuit Protection
- UL/CSA/TUV/CE MARK Approvals

MODEL SELECTION

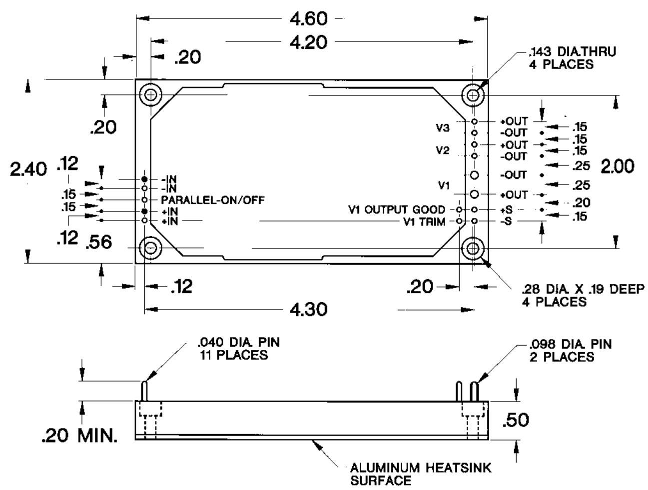
Model	Output Voltage	Output Current
µV300-3	3.3V	50A
µV300-5	5V	40A
µV300-8	8V	30A
µV300-12	12V	20A
µV300-15	15V	16A
µV300-24	24V	10A
µV300-28	28V	9A
µV300-T512	5V	35A*
	12V	3A*
	-12V	3A*
µV300-T515	5V	35A*
	15V	3A*
	-15V	3A*

*Maximum Total Output Power 185 W.
Option:– A Output Good Deleted
– S Sync. Pin Option

SINGLE OUTPUT



TRIPLE OUTPUT



Note: Filled Pins (marked •) are not provided in µV300 series models

UV300 MICROVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Units	Conditions
INPUT	Input voltage	220	300	400	VDC	
	Brownout	180			VDC	75% full output
	In rush charge		4.5x10-5		Coulombs	
	Input reflected ripple		20		%	full load, nominal line
	No load power dissipation		2.5		watts	singles
			7.5		watts	triples
	Logic disabled power in		1		watts	
	Input ripple rejection		60		dB	@ 120 Hz
OUTPUT	(Singles and Main Output of Triple)					
	Set point accuracy			±1	%	no load
	Load regulation		.02	.2	%	0 to full load
	Line regulation		.02	.2	%	over range
	Ripple		1	3	%p-p	0 to 20MHz
	Trim range	±10			%	consult factory for extended range
	Remote sense compensation			0.5	V total	
	OVP (non shutdown auto. recovery)		120*		%	* or Vout +.5V whichever is greater
	Current Limit (auto.recovery)		110-120		%	full load
	Current sharing (automatic)		±5		%	full load
	Transient response singles		50		µs	20-80% load,.5A/µs, Vout 1%
	Transient response main output triples	200			µs	10-20A, aux. loads 2.5A, .25A/µs, Vout 1%
	Transient response	*See web site: www.astrodyne.com*				
	Temp drift			.02	%/°C	
	Efficiency	*See Curves on Page 58*				
OUTPUT	(Auxiliary Outputs of Triples)					
	Set point accuracy		±0.5	±1	%	10A on main, no load auxiliaries
	Load regulation		.2	.5	%	0 to full load
	Line regulation		.01	.1	%	over range
	Ripple		.25	.5	%p-p	0 to 20 mHz
	Current Limit (auto.recovery)		110-120		%	full load
	Transient response		200		µs	20-80% load, Vout within 1%
	Transient response		200		µs	low line to high line, Vout 1%
	Transient response		200		µs	50-100% load, Vout 1%
	Temp drift		.06		%/°C	
CONTROL	Turn on time		250		ms	input power applied, Vout 1%
	Logic turn on time		2		ms	Vout within 1%
	Logic disabled current		1		mA	sink
ISOLATION	Input to output	4500			VDC	consult factory for procedure
	Input to case	2500			VDC	
	Output to case	500			VDC	
	Input to output capacity		5700		pF	
THERMAL	Operating temperature	-40		+100	°C case	
	Automatic shut down temperature	+100	+105	+110	°C case	
	Thermal resistance case to ambient		4.2		°C/w	single @ Tc=100°C
			3.3		°C/w	triple @ Tc=100°C
WEIGHT	singles		7		oz.	
	triples		9		oz.	
SIZE	singles		0.5x2.4x3.6		inches	
	triples		0.5x2.4x4.6		inches	

Astrodyne Corporation
35 Hampden Road
Mansfield, MA 02048

Tel: (508) 964-6300
Fx: (508) 339-0375
sales@astrodyne.com

uV300-5-164

MICROVERTER® -164 DC-DC Converter

300 VDC Input
275 Watts
3/4 Brick

The MICROVERTER® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MICROVERTER® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-5-164	220-400 VDC	5 (4.0-5.5VDC)	50A

uV300-5-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-5-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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www.roassoc.com

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Astrodyne USA: 1-800-823-8082
Astrodyne Pacific: 886-2-26983458

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperature	Standard	-40	+110	°C	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperature	Standard	-40	+110	°C	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	°C	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=5VDC, Full Load, Tc=25°C unless specified otherwise

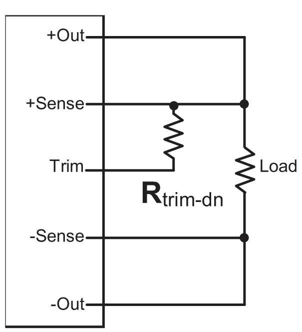
Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.4		ADC	Vin= 220V, Tc= 25°C
			1.5	ADC	Vin=220V, Tc=100°C
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	4.95	5.00	5.05	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		60	100	mV p-p	Vin= 300V, Tc= 25°C
			150	mV p-p	220V<Vin<400V, -40°C<Tc<+100°C
Rated Current			50	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% Vout nominal
Short Circuit Current			170	% Rated	220V< Vin< 400V, Rshort= 15 mohm
Transient Response Deviation		100		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		100		µs	20-80% Rated Current, 0.5A/µs, ± 1%V_o
Efficiency		82		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			M Ohm	500V

ELECTRICAL SPECIFICATIONS Continued

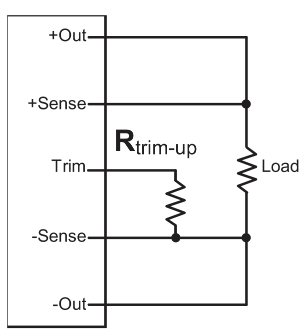
Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		ºC	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		ºC	
	E		105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25ºC
				40	msec	220<Vin<400V, -40ºC<Tc<+100ºC
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		4		5.5	VDC	See Trim Formula and Diagrams
OVP Trip Point		5.9	6.2	6.6	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	May be OVP limited
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Switching Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal

Thermal / Mechanical Parameters	Option	Minimum	Typical	Maximum	Units	Conditions
Thermal Resistance, Case to Ambient			4.2		ºC/W	Free Air, No Heatsink, Tc= 100ºC
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{8.516K\ \Omega}{\Delta V}$$

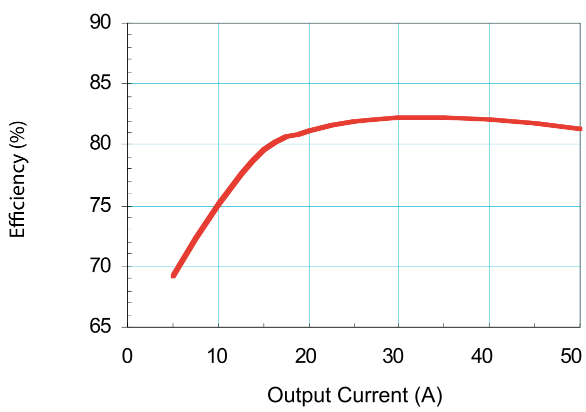
$$R_{trim\text{-}down} = \frac{19.87 - 5.677\ \Delta V}{\Delta V}\ K\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

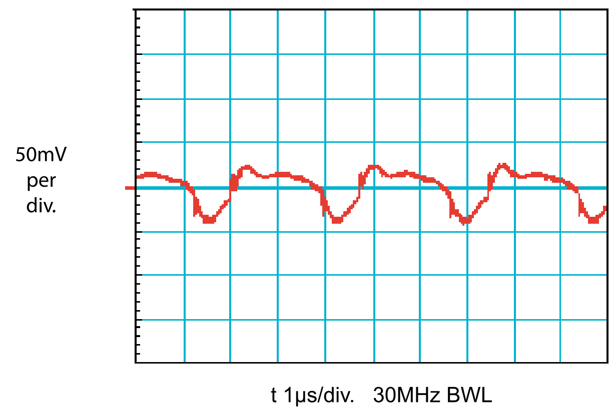
$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

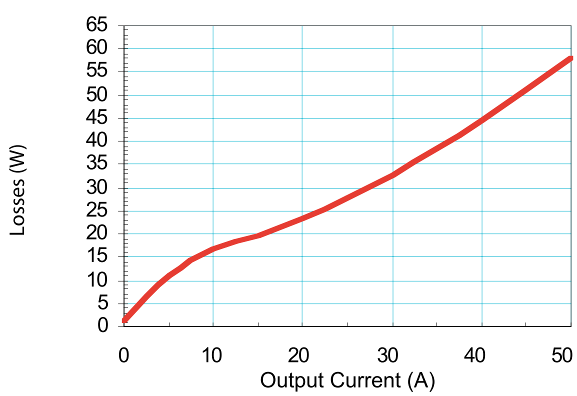
EFFICIENCY VS. LOAD, Vin=300V, TC=25ºC



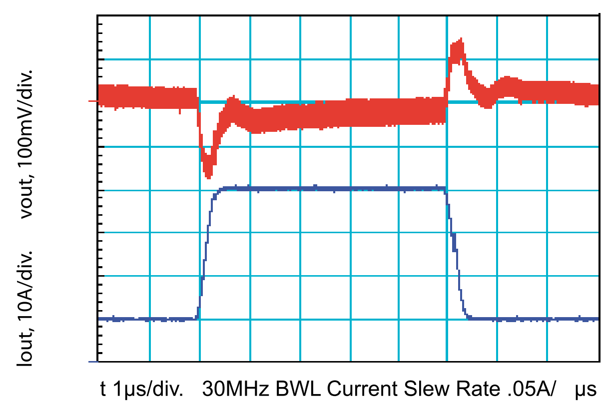
OUTPUT RIPPLE, Vin=300V, Iout=50A, Tc=25ºC



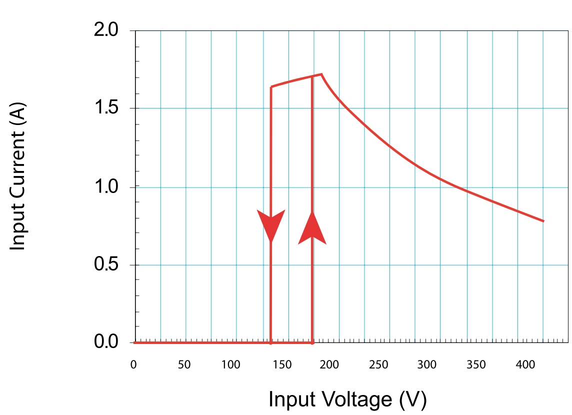
LOSSES VS. LOAD, Vin=300V, TC=25ºC



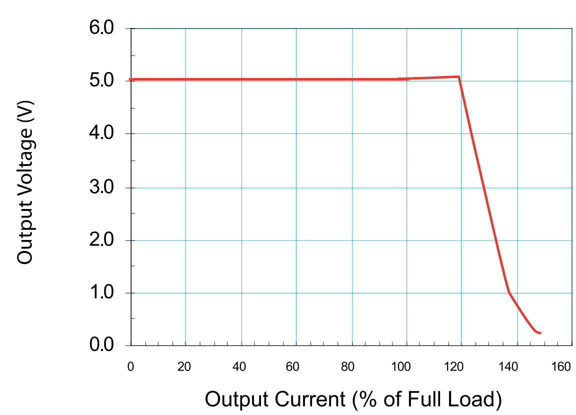
TRANSIENT RESPONSE, Vin=300V, Iout=10A-40A-10A, Tc=25ºC



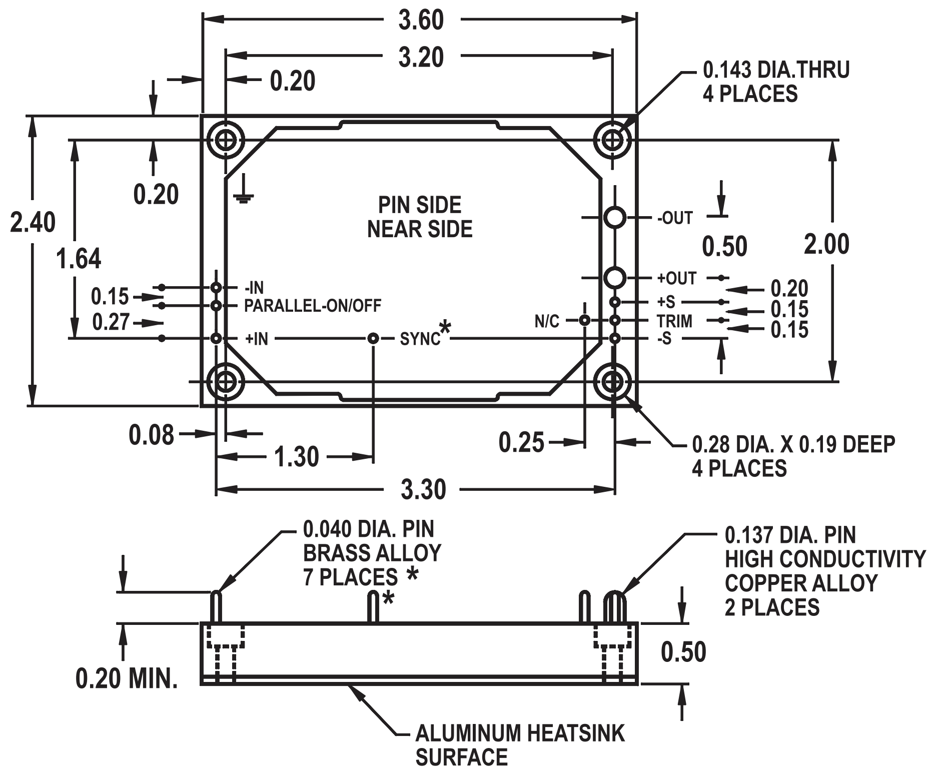
INPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTLINE DRAWING Dimensions in Inches



NOTE:

Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.

* 8 places when ordering sync option.
Location of optional sync pin shown.

NOTES

Astrodyne Corporation
35 Hampden Road
Mansfield, MA 02048

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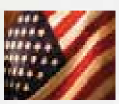
Fx: (508) 339-0375
sales@astrodyne.com

uV300-8-164

MicroVerter® -164 DC-DC Converter

300 VDC Input
288 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.



MADE IN U.S.A.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-8-164	220-400 VDC	8 (6.4-8.8VDC)	36A

uV300-8-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-8-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperature	Standar	-40	+110	°C	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperatur	Standar	-40	+100	°C	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	°C	< 5 sec.

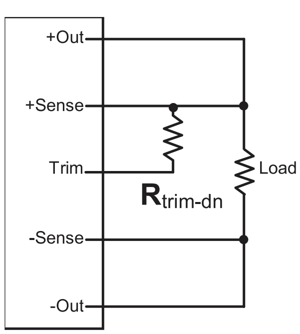
ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=5VDC, Full Load, Tc=25°C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.5		ADC	Vin= 220V, Tc= 25°C
			1.6	ADC	Vin=220V, Tc=100°C
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	7.9f	8.00	8.08	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		80	160	mV p-p	Vin= 300V, Tc= 25°C
			240	mV p-p	220V<Vin<400V, -40°C<Tc<+100°C
Rated Current			36	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% Vout nominal
Short Circuit Current			170	% Rated	220V< Vin< 400V, Rshort= 15 mohm
Transient Response Deviation		240		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		100		µs	20-80% Rated Current, 0.5A/µs, ± 1%V_o
Efficiency		86		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			M Ohm	500V

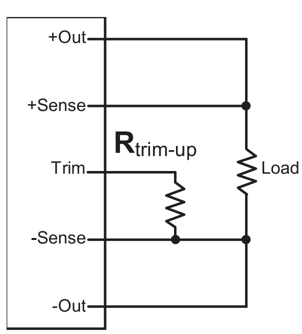
ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		ºC	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		ºC	
	E		105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25ºC
				40	msec	220<Vin<400V, -40ºC<Tc<+100ºC
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		6.4		8.8	VDC	See Trim Formula and Diagrams
OVP Trip Point		9.2	9.6	10.4	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	May be OVP limited
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Switching Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters	**Option**	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		ºC/W	Free Air, No Heatsink, Tc= 100ºC
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{15.84K\ \Omega}{\Delta V}$$

$$R_{trim\text{-}down} = \frac{68.67 - 10.56\ \Delta V}{\Delta V}\ K\Omega$$

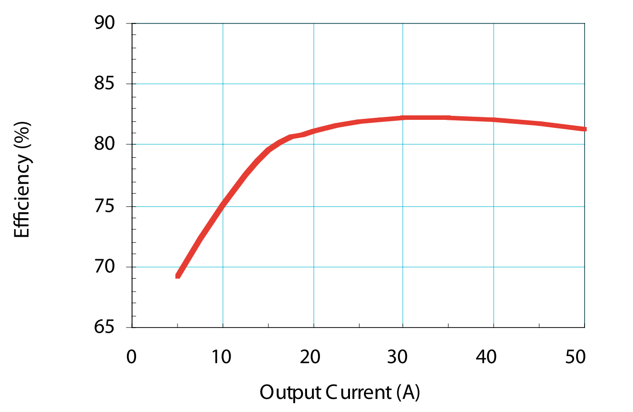
$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

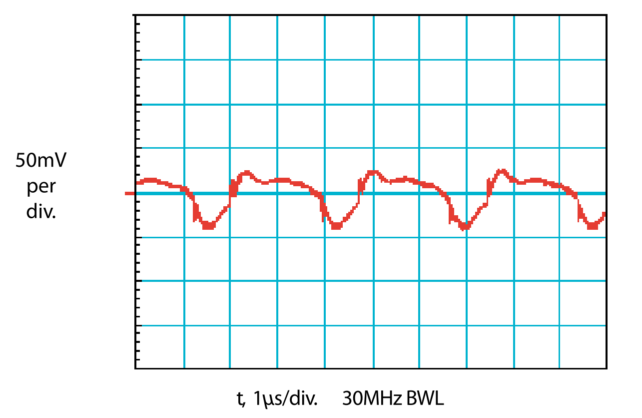
$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

RO

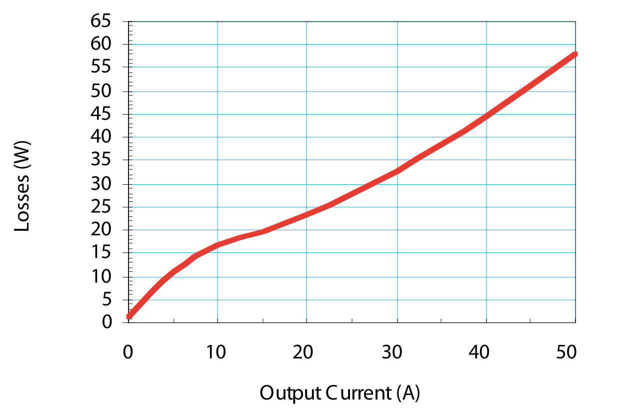
EFFICIENCY VS. LOAD, Vin=300V, TC=25ºC



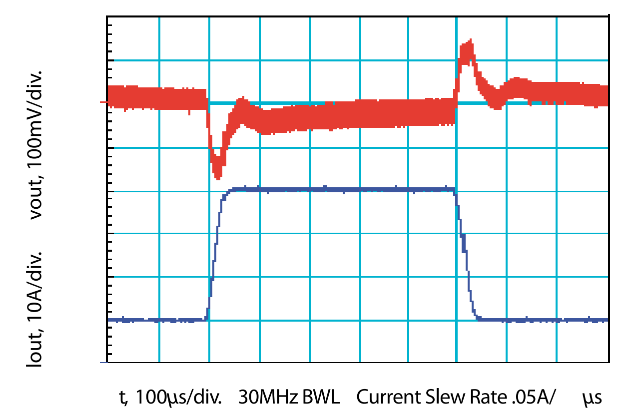
OUTPUT RIPPLE, Vin=300V, Iout=50A, Tc=25ºC



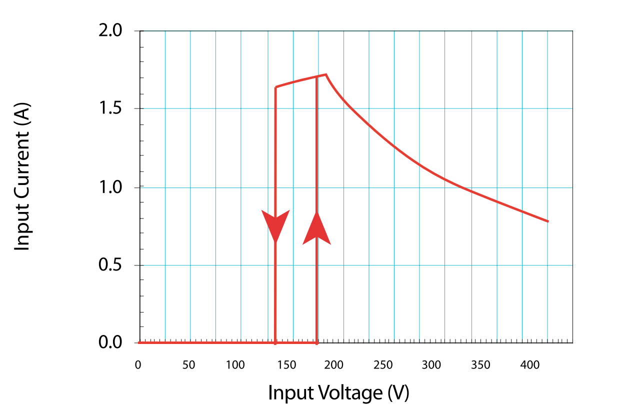
LOSSES VS. LOAD, Vin=300V, TC=25ºC



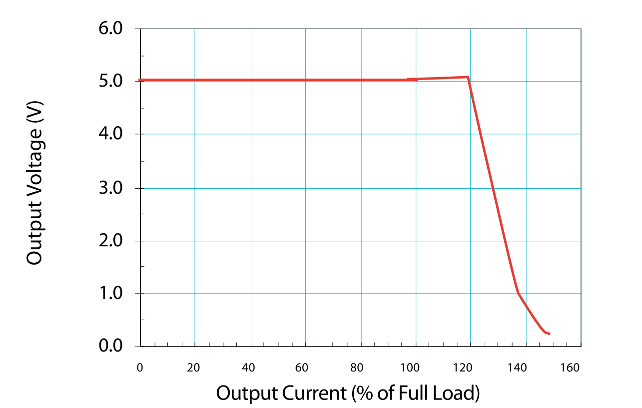
TRANSIENT RESPONSE, Vin=300V, Iout=10A-40A-10A, Tc=25ºC



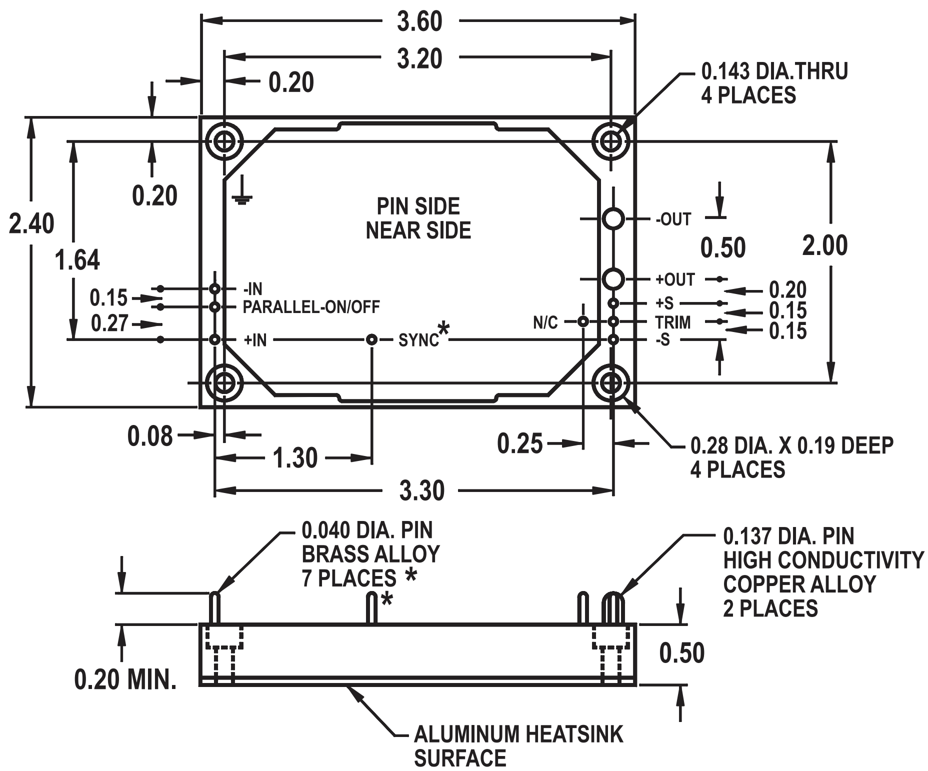
INPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTLINE DRAWING Dimensions in Inches



NOTE:

Pin finish is gold over nickel, JESD97 2nd level interconnect category e4.

* 8 places when ordering sync option. Location of optional sync pin shown.

NOTES

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sales@astrodyne.com

uV300-12-164

MicroVerter® -164 DC-DC Converter

300 VDC Input
300 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-12-164	220-400 VDC	12 (10.8-13.2 VDC)	25A

uV300-12-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-12-STC-164RL
Synchronization, -55°C to 100°C, Conformal Coating, No Pure Tin

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uV300-12-164

300 VDC Input / 300 Watts / 3/4 Brick

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperatur	Standard	-40	+110	°C	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperature	Standard	-40	+100	°C	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	°C	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=12VDC, Full Load, Tc=25°C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.6		ADC	Vin= 220V, Tc= 25°C
			1.9	ADC	Vin=220V, Tc=100°C
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	11.88	12.01	12.12	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		130	240	mV p-p	Vin= 300V, Tc= 25°C
			360	mV p-p	220V<Vin<400V, -40°C<Tc<+100°C
Rated Current			25	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% of Vout nominal
Short Circuit Current			170	% Rated	220V<Vin<400V, Rshort=15 mohm
Transient Response Deviation		800		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs, ±1% V_o
Efficiency		85		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			M Ohm	500V

uV300-12-164

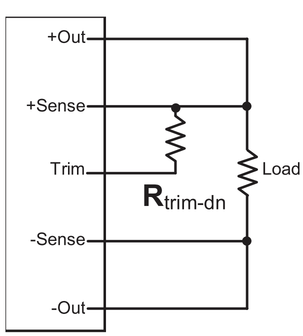
300 VDC Input / 300 Watts / 3/4 Brick

ELECTRICAL SPECIFICATIONS Continued

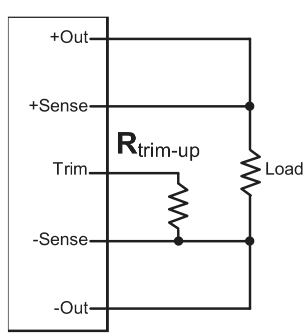
Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		ºC	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		ºC	
	E		105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25ºC
				40	msec	220<Vin<400V, -40ºC<Tc<+100ºC
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		10.8		13.2	VDC	See Trim Formula and Diagrams
OVP Trip Point		14.7	14.9	15.8	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Switching Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal

Thermal / Mechanical Parameters	Minimum	Typical	Maximum	Units	Conditions
Thermal Resistance, Case to Ambient		4.2		ºC/W	Free Air, No Heatsink, Tc=100ºC
Size, HxWxL		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{\text{trim-up}} = \frac{29.01\text{K}\ \Omega}{\Delta V}$$

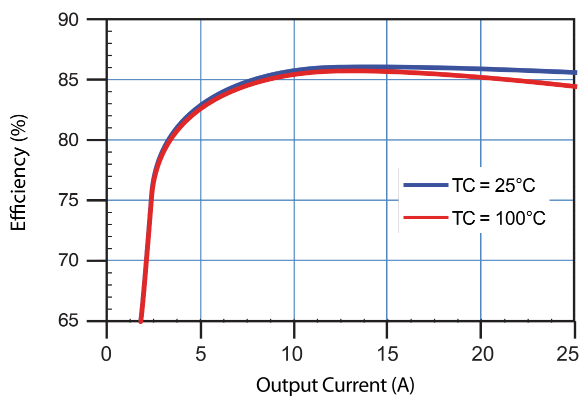
$$R_{\text{trim-down}} = \frac{203.0-19.34\ \Delta V}{\Delta V}\ \text{K}\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

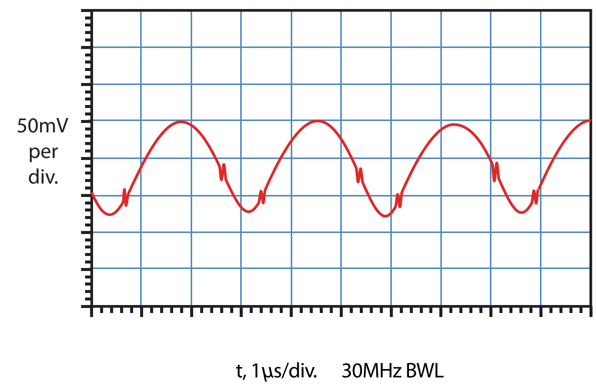
$R_{\text{trim-up}} =$ External Resistor Value to Increase V_{out}

$R_{\text{trim-down}} =$ External Resistor Value to Decrease V_{out}

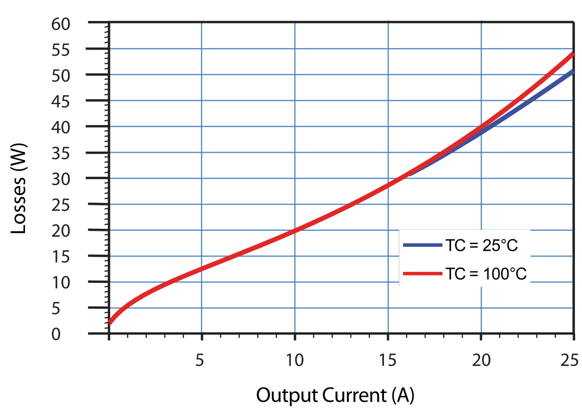
EFFICIENCY VS. LOAD, Vin=300V



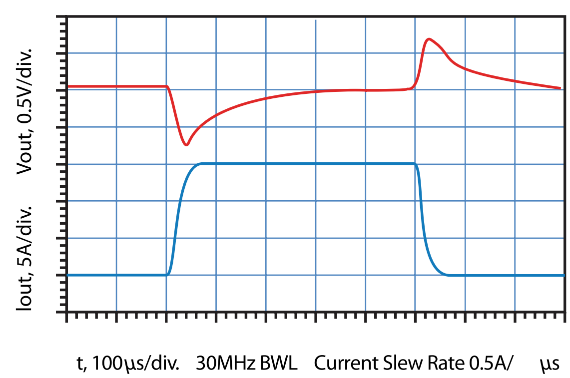
OUTPUT RIPPLE, Vin=300V, Iout=25A, Tc=25°C



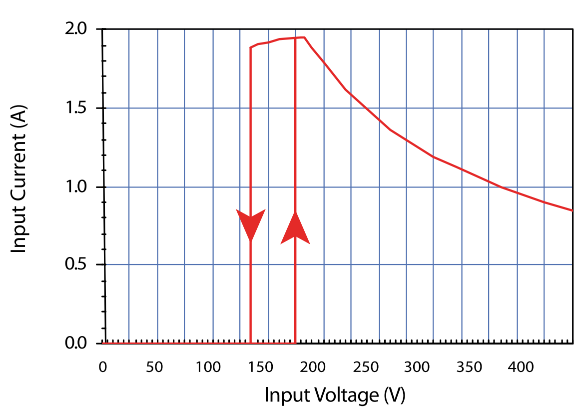
LOSSES VS. LOAD, Vin=300V



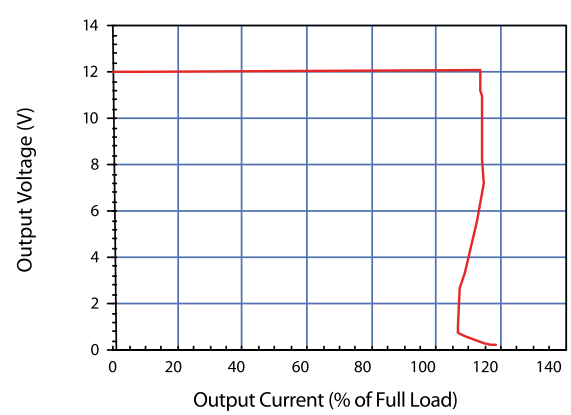
TRANSIENT RESPONSE, Vin=300V, Iout=5A-20A-5A, Tc=25°C



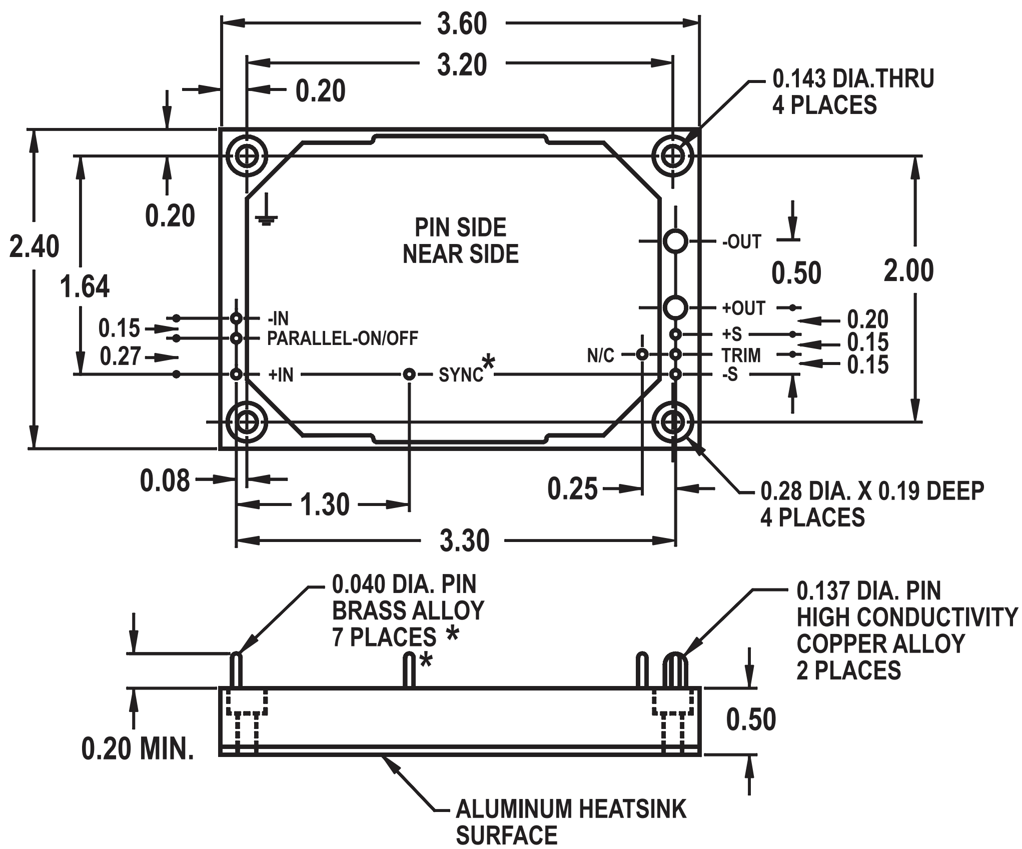
INPUT CHARACTERISTIC, Iout = 25A, TC=25°C



OUTPUT CHARACTERISTIC, Vin=300V, TC=25°C



OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 8 places when ordering sync option.
Location of optional sync pin shown.

NOTES

REV 090410

RO

Astrodyne Corporation
35 Hampden Road
Mansfield, MA 02048

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Fx: (508) 339-0375
sales@astrodyne.com

uV300-15-164

MICROVERTER® -164 DC/DC Converter

300 VDC Input
300 Watts
3/4 Brick

The MICROVERTER® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MICROVERTER® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-15-164	220-400 VDC	15 (12-16.5 VDC)	20A

uV300-15-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-15-STC-164RL
Synchronization, -55 °C to 100°C, Conformal Coating, No Pure Tin

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uV300-15-164

300 VDC Input / 300 Watts / 3/4 Brick

RO

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperature	Standard	-40	+110	ºC	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperature	Standard	-40	+100	ºC	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	ºC	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=15VDC, Full Load, Tc=25ºC unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.56	1.64	ADC	Vin=220V, Tc=25ºC
			1.64	ADC	Vin=220V, Tc=100ºC
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	14.85	15.00	15.15	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / ºC	Tc min to Tc max
Ripple (PARD)		100	300	mV p-p	Vin= 300V, Tc= 25ºC
			450	mV p-p	220V<Vin<400V, -40ºC<Tc<+100ºC
Rated Current			20	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% Vout nominal
Short Circuit Current			170	% Rated	220V<Vin<400V, Rshort=15 mohm
Transient Response Deviation		800		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs, ±1%V_o
Efficiency		86		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			M Ohm	500V

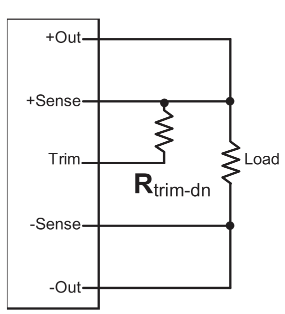
uV300-15-164

300 VDC Input / 300 Watts / 3/4 Brick

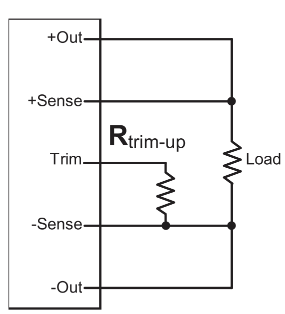
ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		°C	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		°C	
	E		105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25°C
				40	msec	220<Vin<400V, -40°C<Tc<+100°C
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		12		16.5	VDC	See Trim Formula and Diagrams
OVP Trip Point		17.6	18.6	19.75	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Switching Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters		**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		°C/W	Free Air, No Heatsink, Tc= 100°C
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{29.84K\ \Omega}{\Delta V}$$

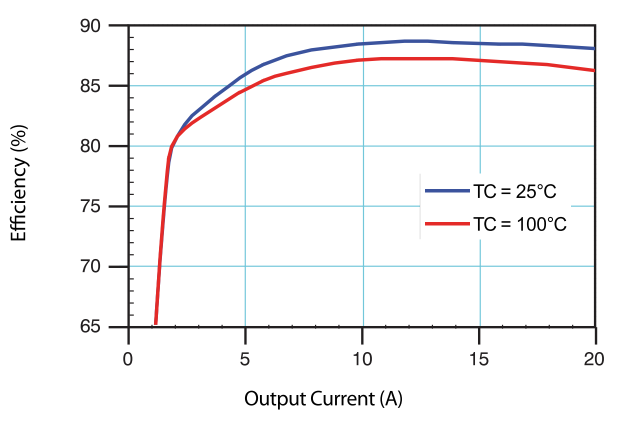
$$R_{trim\text{-}down} = \frac{268.5 - 19.89\ \Delta V}{\Delta V}\ K\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

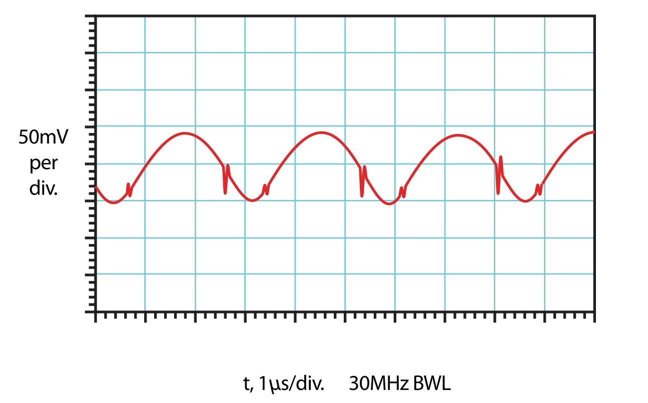
$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

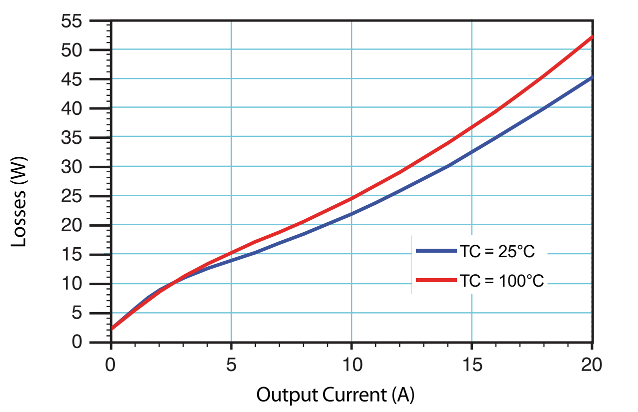
EFFICIENCY VS. LOAD, Vin=300V



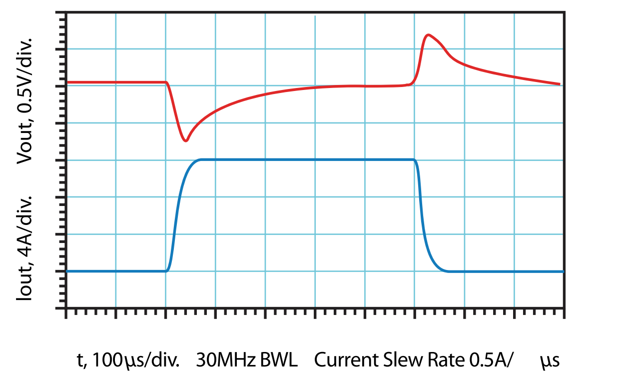
OUTPUT RIPPLE, Vin=300V, Iout=20A, Tc=25ºC



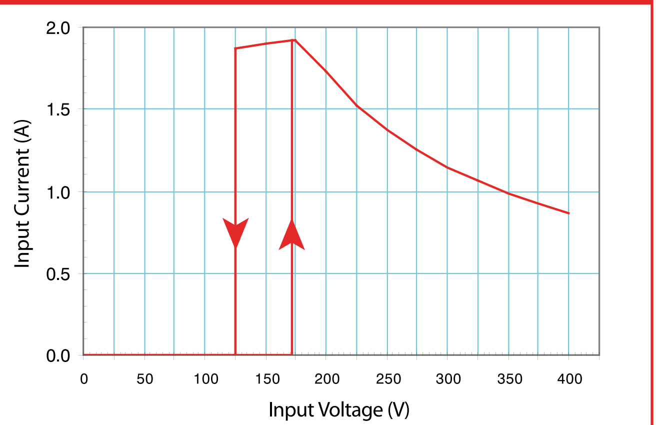
LOSSES VS. LOAD, Vin=300V



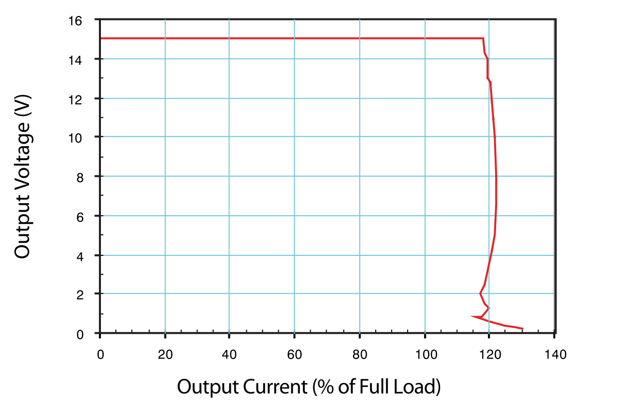
TRANSIENT RESPONSE, Vin=300V, Iout=4A-16A-4A, Tc=25ºC



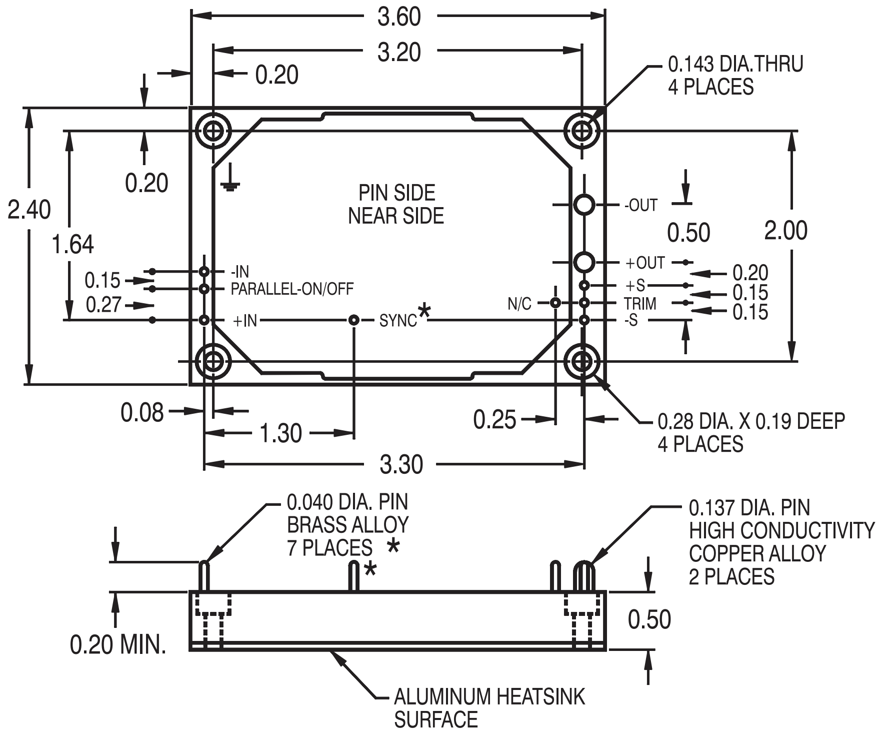
INPUT CHARACTERISTIC, Iout =20A, TC=25ºC



OUTPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTLINE DRAWING Dimensions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 8 places when ordering sync option.
Location of optional sync pin shown.

NOTES

Astrodyne Corporation
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Mansfield, MA 02048

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uV300-24-164

MicroVerter® -164 DC/DC Converter

300 VDC Input
300 Watts
3/4 Brick

The MicroVerter® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MicroVerter® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-24-164	220-400 VDC	24 (21.6-26.4 VDC)	12.5A

uV300-24-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-24-STC-164RL
Synchronization, -55 °C to 100°C, Conformal Coating, No Pure Tin

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ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperature	Standard	-40	+110	°C	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperature	Standard	-40	+100	°C	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	°C	< 5 sec.

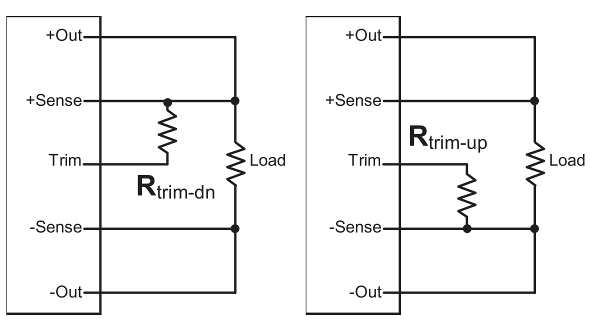
ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=24VDC, Full Load, Tc=25°C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.6		ADC	Vin= 220V, Tc= 25°C
			1.9	ADC	Vin=220V, Tc=100°C
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	23.76	24.01	24.24	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		170	300	mV p-p	Vin= 300V, Tc= 25°C
			450	mV p-p	220V<Vin<400V, -40°C<Tc<+100°C
Rated Current			12.5	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% Vout nominal
Short Circuit Current			170	% Rated	220V< Vin< 400V, Rshort= 15 mohm
Transient Response Deviation		1600		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs, ±1% V_o
Efficiency		88		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			M Ohm	500V

ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		°C	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		°C	
	E		105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25°C
				40	msec	220<Vin<400V, -40°C<Tc<+100°C
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		21.6		26.4	VDC	See Trim Formula and Diagrams
OVP Trip Point		28.3	29.8	31.7	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Switching Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters		**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		°C/W	Free Air, No Heatsink, Tc= 100°C
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down   Trim Up

$$R_{\text{trim-up}} = \frac{62.16\text{K } \Omega}{\Delta V}$$

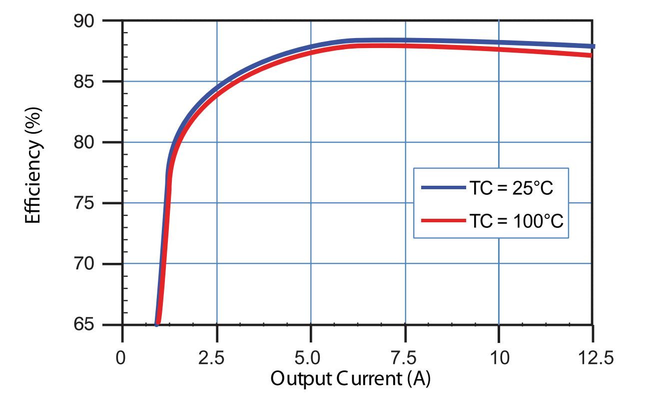
$$R_{\text{trim-down}} = \frac{932.3 - 41.44\ \Delta V}{\Delta V}\ \text{K}\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

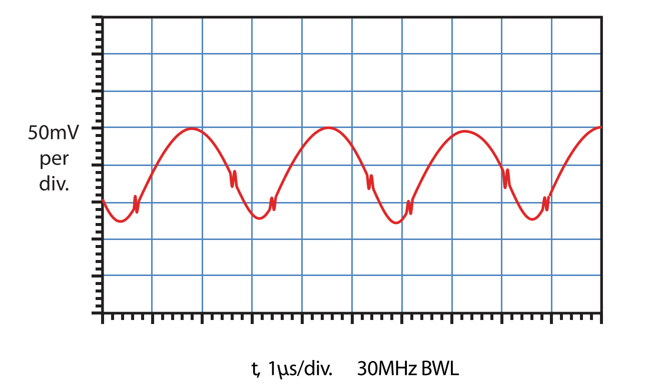
$R_{\text{trim-up}} =$ External Resistor Value to Increase V_{out}

$R_{\text{trim-down}} =$ External Resistor Value to Decrease V_{out}

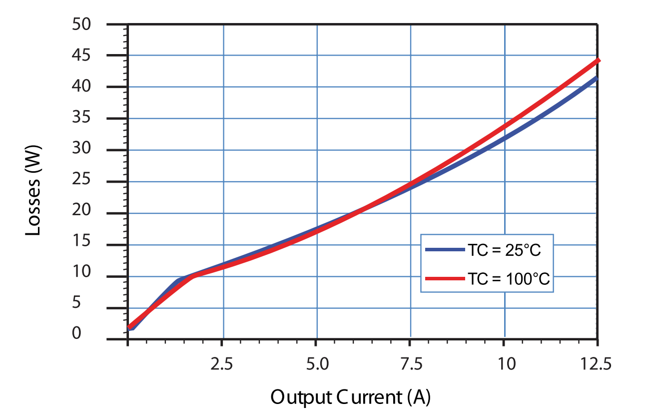
EFFICIENCY VS. LOAD, Vin=300V



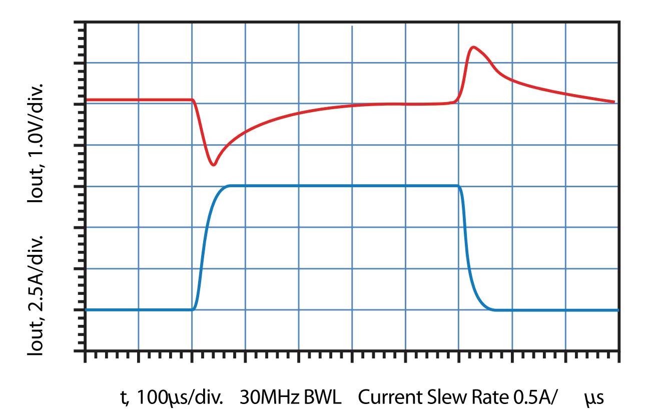
OUTPUT RIPPLE, Vin=300V, Iout=12.5A, Tc=25°C



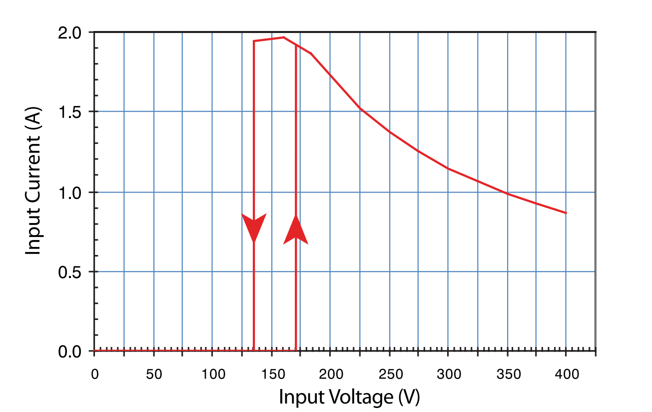
LOSSES VS. LOAD, Vin=300V



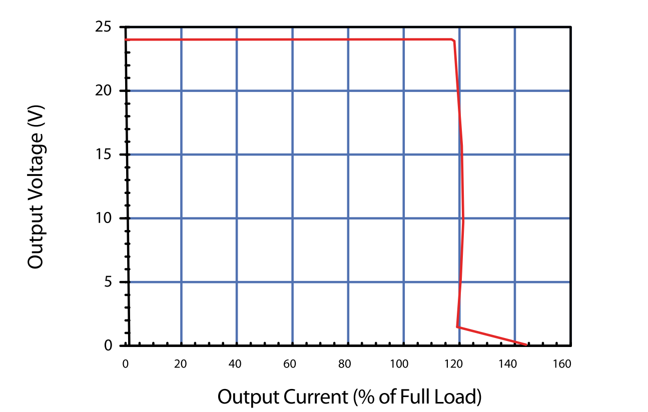
TRANSIENT RESPONSE, Vin=300V, Iout=2.5A-10A-2.5A, Tc=25°C



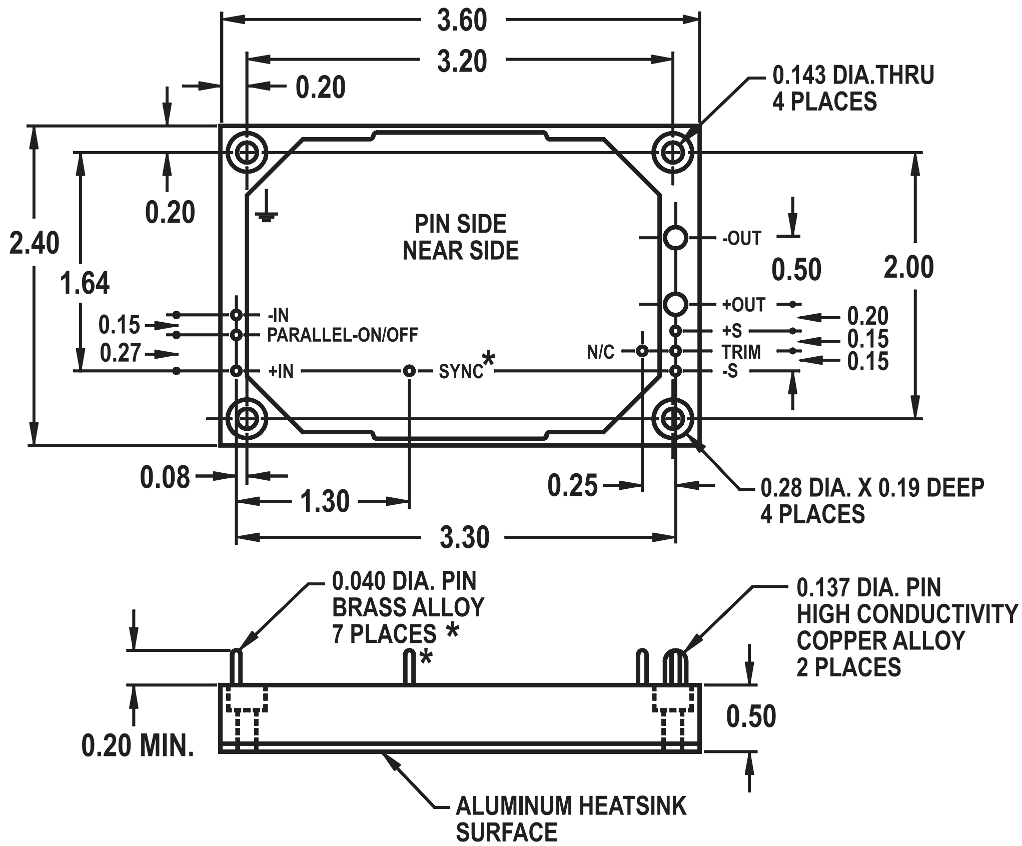
INPUT CHARACTERISTIC, Iout = 12.5A, TC=25°C



OUTPUT CHARACTERISTIC, Vin=300V, TC=25°C



OUTLINE DRAWING Dimensions in Inches



NOTE:

Pin finish is gold over nickel, JESD97 2nd level interconnect category e4.

* 8 places when ordering sync option. Location of optional sync pin shown.

NOTES

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uV300-28-164

MICROVERTER® -164 DC/DC Converter

300 VDC Input
300 Watts
3/4 Brick

The MICROVERTER® 164 Series is a second generation product which combines high efficiency electrical power design and proprietary advanced thermal management techniques including insulated metal substrate technology, specialty dielectrics and formulated thermally conductive potting to produce small, ruggedized DC/DC converters with reduced temperature rise and increased reliability. This series is ideal for use in rugged, thermally challenged applications requiring baseplate cooled operation such as military systems, RF/power amplifiers, commercial avionics and industrial control. All RO products are normally manufactured using a tin-lead soldering process. The MICROVERTER® 164 Series is also available in both full RoHS compliant (utilizing lead free solder) and full tin-lead (no pure tin) configurations. All models are designed to meet international safety standards.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100°C Baseplate Operation – Standard
  -55 ~ 125°C Baseplate Operation – Optional
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output
- Synchronizable from 330-400KHz (Optional)
- 2 Year Warranty

ORDERING INFORMATION

Model Number	Input Voltage Range	Output Voltage	Output Current
uV300-28-164	220-400 VDC	28 (25.2-30.8 VDC)	11A

uV300-28-XXX-164YY

XXX ← → YY

S= Synchronization 330-400KHz
T= -55°C to 100°C Operating Temperature
C= Conformal Coating
E= -55°C to 125°C (Consult the factory for output power rating)

RL= No Pure Tin
LF= RoHS Compliant
no suffix is required for standard tin-lead finish

Part Number Example: uV300-28-STC-164RL
Synchronization, -55 °C to 100°C, Conformal Coating, No Pure Tin

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RO

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Option	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)		-0.3	400	VDC	Continuous
Transient Input Voltage (+In to -In)		-0.3	450	VDC	100 msec. Max.
Input/Output Isolation			4500	VDC	
Input/Case Isolation			2500	VDC	
Output/Case Isolation			500	VDC	
Storage Temperature	Standard	-40	+110	ºC	
	T	-55	+110	°C	
	E	-55	+130	°C	
Operating Temperature	Standard	-40	+100	ºC	Baseplate
	T	-55	+100	°C	Baseplate
	E	-55	+125	°C	Baseplate
Soldering Temperature (Wave Solder)			260	ºC	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=300VDC, Vout=28VDC, Full Load, Tc=25ºC unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	220	300	400	VDC	
Maximum Input Current		1.8		ADC	Vin= 220V, Tc= 25ºC
			2.0	ADC	Vin=220V, Tc=100ºC
Input Ripple Rejection		70		dB	f= 120Hz, Vin ripple= 15V p-p
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	27.72	28.01	28.28	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / ºC	Tc min to Tc max
Ripple (PARD)		170	300	mV p-p	Vin= 300V, Tc= 25ºC
			450	mV p-p	220V<Vin<400V, -40ºC<Tc<+100ºC
Rated Current			11	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% Vout nominal
Short Circuit Current			170	% Rated	220V< Vin< 400V, Rshort= 15 mOhm
Transient Response Deviation		1600		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		200		µs	20-80% Rated Current, 0.5A/µs, ±1% V_o
Efficiency		88		%	Vin= 300V, Iout= 75% Rated
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output	4500			VDC	Special Test Method Required
Input-to-Case	2500			VDC	
Output-to-Case	500			VDC	
Input-to-Output Capacitance		5600		pF	
Input-to-Output Resistance	10			Meg Ohm	500V

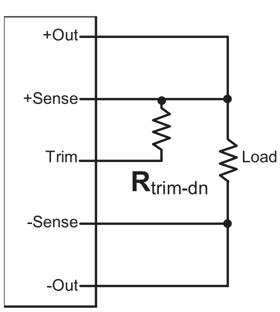
uV300-28-164

300 VDC Input / 300 Watts / 3/4 Brick

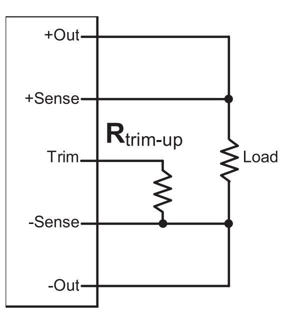
ELECTRICAL SPECIFICATIONS Continued

Control	Option	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)	Standard & T		105		°C	
	E		130		°C	
Over Temperature Restart Temp (Tc)	Standard & T		85		°C	
			105		°C	
Start-up Voltage			175	200	VDC	
Input Under Voltage Lock Out			130		VDC	
Turn-on Time			18	30	msec	220< Vin< 400V, Tc= 25°C
				40	msec	220<Vin<400V, -40°C<Tc<+100°C
Logic On/Off Enable Signal			Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal				0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time			5	10	msec	
Trim Range		25.2		30.8	VDC	See Trim Formula and Diagrams
OVP Trip Point		31.2	32.9	35.0	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation				0.5	VDC	
Current Sharing (Parallel Operation)			5		%	Using Parallel Pin Connection or PDM
Switching Frequency			370		KHz	Standard Model
			300		KHz	-S Sync Option Model
Synchronization Frequency Range		330		440	KHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters		**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient			4.2		°C/W	Free Air, No Heatsink, Tc= 100°C
Size, HxWxL			0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight			5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{\text{trim-up}} = \frac{62.75K\ \Omega}{\Delta V}$$

$$R_{\text{trim-down}} = \frac{1109-41.83\ \Delta V}{\Delta V}\ K\Omega$$

$\Delta V = |$ Desired Output Voltage Change (Volts) $|$

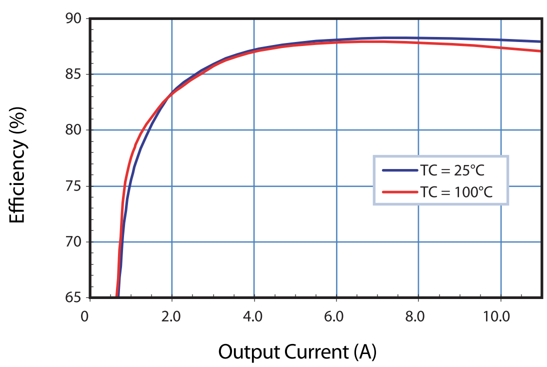
$R_{\text{trim-up}} =$ External Resistor Value to Increase V_{out}

$R_{\text{trim-down}} =$ External Resistor Value to Decrease V_{out}

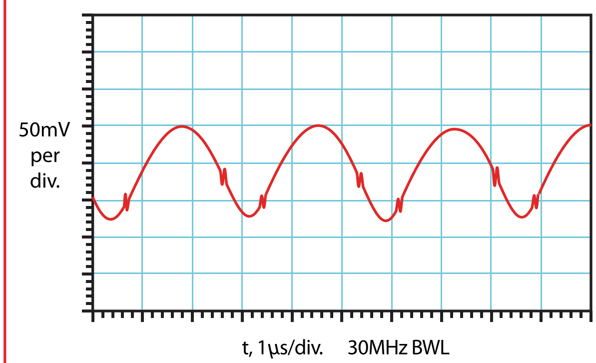
uV300-28-164

300 VDC Input / 300 Watts / 3/4 Brick

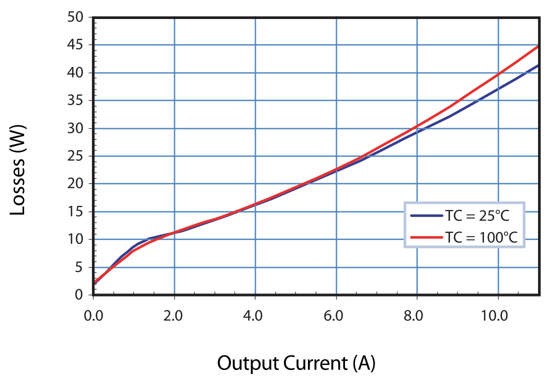
EFFICIENCY VS. LOAD, Vin=300V



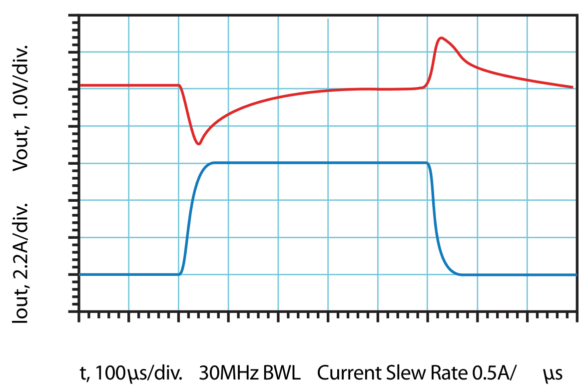
OUTPUT RIPPLE, Vin=300V, Iout=11.0A, Tc=25ºC



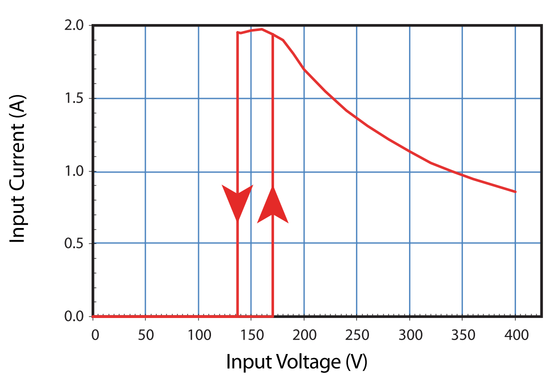
LOSSES VS. LOAD, Vin=300V



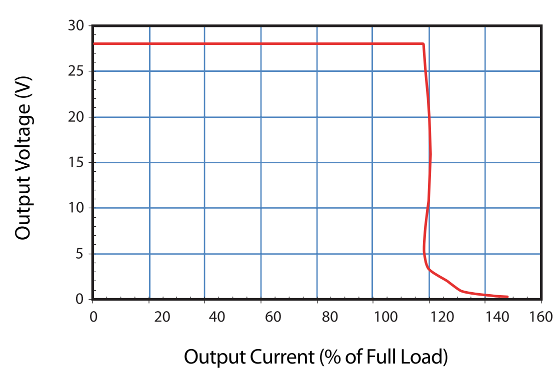
TRANSIENT RESPONSE, Vin=300V, Iout=2.2A-8.8A-2.2A, Tc=25ºC



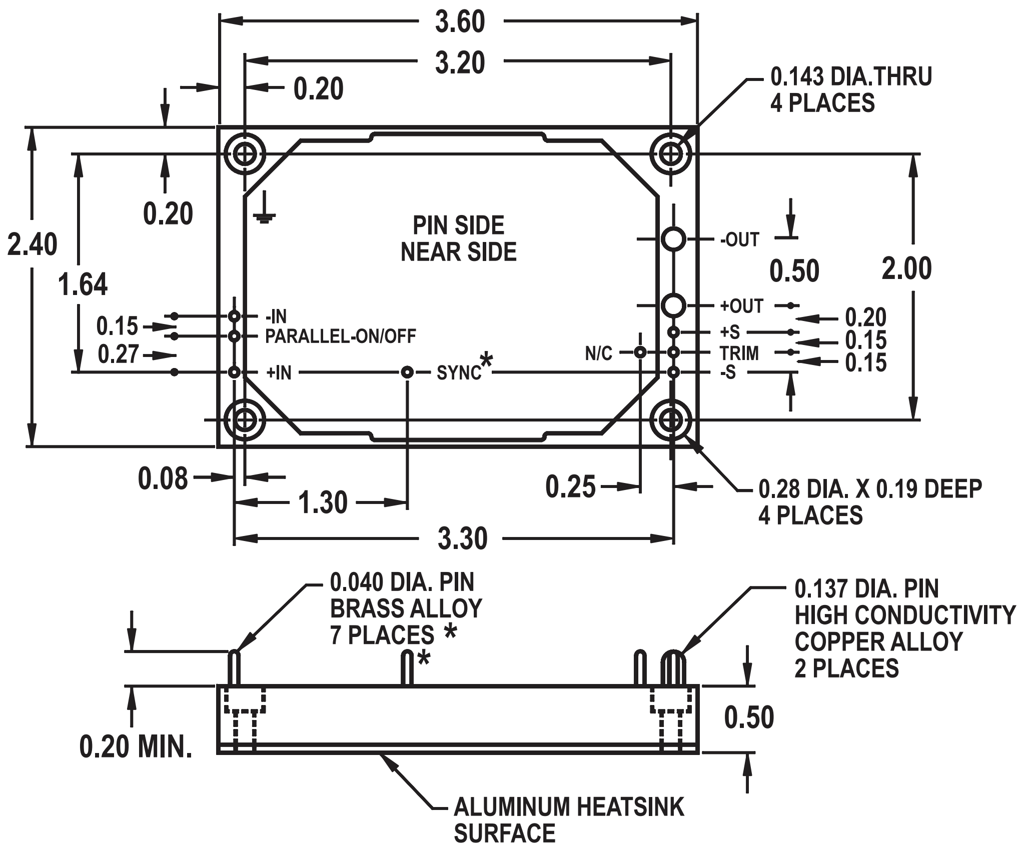
INPUT CHARACTERISTIC, Iout = 11.0A, TC=25ºC



OUTPUT CHARACTERISTIC, Vin=300V, TC=25ºC



OUTLINE DRAWING Dimensions in Inches



NOTE:

Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.

* 8 places when ordering sync option.
Location of optional sync pin shown.

NOTES

REV 090410

NV300 NANOVERTER® SERIES

63-120 WATTS 300VDC INPUT 1/2 BRICK SECONDARY REFERENCED

DESCRIPTION

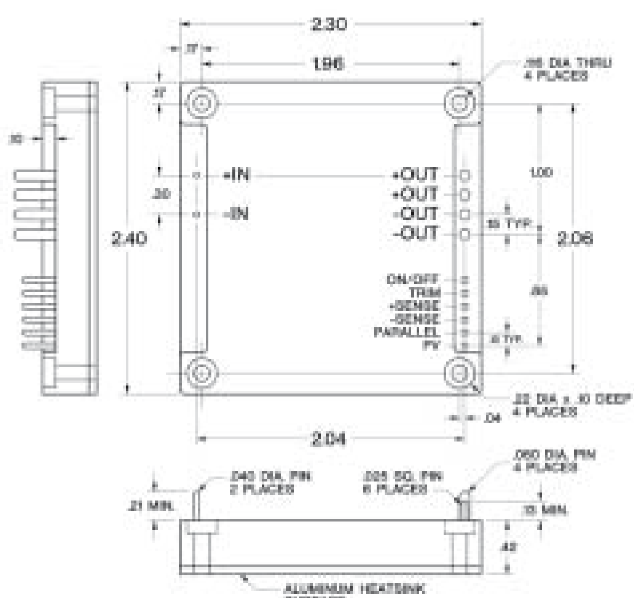
NanoVerter modules are high density DC-DC converters designed for use in telecom and other centralized modular and distributed power applications. Two input voltage ranges are available and all use metal PC boards, planar transformers, and surface mount construction to produce up to 120 watts in a tiny package.

FEATURES

- Miniature Size – Low Profile .42” –.32” with Recessed Mounting
- Constant Frequency Operation
- High Density – Up to 52 W/in.^{3}
- High Efficiency
- Extremely Low Thermal Resistance
- 100°C Baseplate Operation
- Parallelable with Current Sharing
- Fault Tolerant – True n+1... n+m
- Redundancy
- Hot Plug-In Capability
- Secondary Referenced Controls
- Auxiliary (housekeeping) Supply Output (PV pin)
- Logic On-Off
- Non-Shutdown Over Voltage Protection
- Safety Agency Approved

MODEL SELECTION

Input	Output Voltage	Output Current
300 VDC		
(220-400V)		
nV300-3	3.3V	25A
nV300-5	5V	20A
nV300-12	12V	10A
nV300-15	15V	8A
nV300-24	24V	5A



NV300 NANOVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Conditions
INPUT	Input voltage	220VDC	300VDC	400VDC	
	Input reflected ripple		10%		full load, nominal line
	Input ripple rejection		60dB		@120Hz
	No load power dissipation		1.5W		nominal line
	Logic disabled power in		0.8W		
OUTPUT	Set point accuracy		± 0.5%	1%	full load
	Load regulation		0.1%	0.2%	0 - full load
	Line regulation		0.1%	0.2%	36 - 72VDC
	Ripple		1%	3%	0 - 20MHz < 5V outputs
			1%	2%	0 - 20MHz ≥ 5V outputs
	Trim range	± 10%*			*± 5% for 2V,+ 5%,-10% for 3V
	Remote sense compensation	0.5V total			outputs ≥ 5V
	OVP (non shutdown auto. rec.)	105%	110%	120%	< 5V outputs
		110%	115%	130%	≥ 5V outputs
	Current Limit (auto.rec.)		115%		full load
	Short circuit current		130%		full load
	Current sharing (automatic)		± 1%	± 5%	full load
	Transient response - Excursion		3%		20 - 80% FL, 1/2 A/µs
	Transient response - Recovery Time		50µs	200µs	Vout 1%
	Temperature drift			.02%/°C	
EFFICIENCY	See Curves on Page 79		80-86%		full load, nominal line
CONTROL	Turn on time (power applied)		150ms		full load, nominal line
	Logic turn on time		2ms		full load, nominal line
	Logic disabled current		20µA		
PV OUTPUT	2mA PV load		10.3V		main output @ full load
	10mA PV load		9.3V		main output @ full load
	2mA PV load		10.3V		main output logic disabled or shorted
ISOLATION	Input to output	4500VDC			
	Input to case	2500VDC			
	Output to case	500VDC			
	Input to output capacity	5200pF			
THERMAL	Operating temperature	-40 °C case	+100 °C case		
	Automatic shut down temperature	+100 °C case	+105 °C case	+110 °C case	
	Thermal resistance case to ambient		6.6 °C/watt		
	Storage temperature	-55 °C		+ 110°C	
WEIGHT		3.4oz. (96 grams)			
SIZE		0.42” x 2.40” x 2.30” (1.07cm x 6.15cm x 6.00cm)			

PV300 PICOVERTER® SERIES

40-60 WATTS   300VDC INPUT   1/2 BRICK   LOW COST

DESCRIPTION

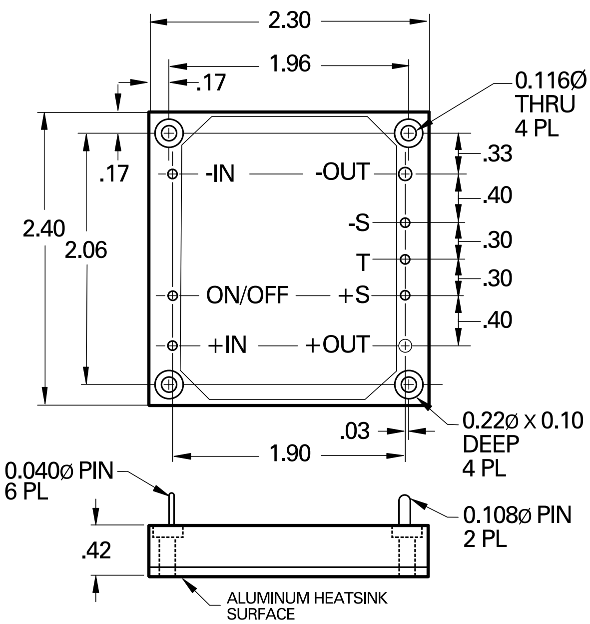
PicoVerter modules are high density DC-DC converters designed for use in telecom and other centralized modular and distributed power applications. All use metal PC boards, planar transformers, and surface mount construction to produce up to 60 watts in a tiny package.

FEATURES

- Miniature Size – Low Profile .42”
- High Efficiency
- Low Cost
- Industry Standard Pin-out
- Low Thermal Resistance
- 100°C Baseplate Operation
- Constant Frequency Operation
- Non-Shutdown Over Voltage Protection
- Logic On/Off
- Fully Automated Manufacturing
- UL/CSA/TUV/CE MARK

MODEL SELECTION

Input	Output Voltage	Output Current
300 VDC		
(220-400V)		
pV300-3	3.3V	12.5A
pV300-5	5V	10A
pV300-12	12V	5A
pV300-15	15V	4A
pV300-24	24V	2.5A



PV300 PICOVERTER SERIES SPECIFICATIONS

		Min	Typical	Max	Conditions
INPUT	Input voltage	220VDC	300VDC	400VDC	
	Input reflected ripple		10%		full load, nominal line
OUTPUT	Set point accuracy		±0.5%	±1%	full load
	Load regulation		0.1%	0.2%	0 - full load
	Line regulation		0.1%	0.2%	220 - 400VDC
	Ripple		1%	3%	0 - 20MHz
	Trim range	±10%			
	Remote sense compensation	0.5V total			
	OVP (non shutdown auto. recovery)	110%	115%	130%	
	Current Limit (auto.recovery)		115%		
	Short circuit current		130%		
	Transient response -				
	Excursion		2%		(20-80% full load, 0.5 A/us)
	Recovery Time		50μs	200μs	Vout 1%
	Temperature drift			.02%/°C	
ISOLATION	Input to output	4500VDC			
	Input to case	2500VDC			
	Output to case	500VDC			
THERMAL	Operating temperature	-40°C case		+100°C case	
	Automatic shut down temperature	+100°C case	+105°C case	+110°C case	
	Thermal resistance case to ambient		6.6 °C/w		
	Storage temperature	-55°C		+110°C	
WEIGHT		3.4oz. (96 grams)			
SIZE		0.42" x 2.40" x 2.30" (1.07cm x 6.10cm x 5.84cm)			

Astrodyne
Now you have power.

PFC-375 Series
Univerter® Power Factor Correction Module

375 Watt PFC Front End

The Univerter PFC-375 Power Factor Correction modules are AC to DC converters that operate from a wide range of AC input voltages and frequencies with extremely high conversion efficiency and near unity power factor. The PFC-375 produces an output of 375 VDC suitable for driving 300V input DC-DC converters, motors, pumps and a host of other loads. The wide AC input voltage range and frequency range are 85 to 265 VAC and 47 to 800 Hz respectively, making this product suitable for land, sea and air based applications requiring AC to DC conversion with line harmonic reduction or PFC. Typical applications include 115/230 VAC, 50/60 Hz systems and 115 VAC, 400 Hz or 360-800 Hz military and commercial aircraft power systems requiring MIL-STD-704 or DO-160 compliance. These compact, rugged modules use advanced electrical design and thermal management techniques to make them suitable for harsh environments and thermally challenged applications.

Compact 1/2 Brick Package
2.4 x 2.3 x 0.5 in.

FEATURES

- Optimized for Airborne and other Harsh Environment Applications
- 85-265 VAC INPUT, 47-800Hz
- 375VDC Output
- Efficiency 94% typical 115VAC, 400Hz Input, 97% typical at 230VAC, 50Hz input
- Extremely High Power Factor and Low THD
- Potted Module with Metal Substrate Technology
- -40°C to +100°C Base Plate Rated – No Output Power Derating
- Available in Lead Free ROHS Compliant or SnPb Solder Versions
- Ride-Through Time is essentially unlimited, depends only on the Bulk Cap Voltage

MODEL SELECTION

PFC-375 □□□ - □□ - □□□

Standard Options (0, 1, 2 or 3 characters):
Blank: Standard
A: Vaux Option
T: Extended Operating Temp Range -55 to +100°C
C: Conformal coating

Solder Option (Blank or 2 characters):
Blank: Standard SnPb Solder
LF: ROHS Compliant Lead Free Solder Option
RL: Tin-Free Construction (SnPb Solder – no pure tin)

Special Configurations (3 characters):
Assigned by Astrodyne

Astrodyne USA: 1-800-823-8082
Astrodyne Pacific: 886-2-26983458

PFC-375 Series

375 Watt Power Factor Correction Module
375 VDC Output, ½ Brick Package

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability					
PARAMETER	**OPTION**	**MINIMUM**	**MAXIMUM**	**UNITS**	**CONDITIONS**
Input Voltage (AC1 to AC2)			265	VAC	Continuous
Input Voltage (AC1 to AC2)			311	VAC	100ms max.
Circuit-to-Case Voltage			2500	Vdc	
Storage Temperature	Standard	-55	110	°C	
Operating Temperature	Standard	-40	100	°C	Baseplate
Operating Temperature	T	-55	100	°C	Baseplate
Soldering Temperature			260	°C	< 5 sec

SPECIFICATIONS

Electrical specifications apply for in = 115Vac, 60 Hz to 400 Hz Full Load, Tc = 25 °C and external application circuit components shown in figure 1, unless specified otherwise.

INPUT SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Input Voltage	85	115/230	265	VAC	
Input Line Frequency	47	50/60/400	800	Hz	
Power Factor	0.99		1.0		60 Hz
Total Harmonic Distortion		<5%		%	Conforming to IEC 1000-3-2
Maximum Input Current		3.5	4.5	Arms	Vin = 90VAC, Full Load, Tc = 25°C
Inrush Current					
Input 115 Vac		15		Apeak	Thermistor Temperature 25°C
Input 230 Vac		30		Apeak	Thermistor Temperature 25°C
Start-up Voltage			80	VAC	
*Ride Through time		75		ms	Vin = 115VAC, 60Hz

*Note: Ride Through is indefinite if output is held above 220V.

OUTPUT SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Output Voltage	370	375	380	Vdc	Vin = 115VAC, Tc = 25°C
Output Over Voltage Protection			415	Vdc	Non-shutdown Vmax.
Output Current	0		1.0	ADC	
Output Current Limit		NONE			
Efficiency		94%		%	
Output Ripple		13		V p-p	Vin = 115VAC, f=60Hz
Vaux Output Voltage (OPTION-A)	10	12.5	18.0	Vdc	Vaux Load = 3mA

CONTROL SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
LD ENA Threshold (Vout rising)	355	360	370	Vdc	
LD ENA threshold (Vout falling)	205	220	235	Vdc	
LD ENA Logic Low Current			20	mA	
LD ENA Logic Low Voltage			0.5	Vdc	

ISOLATION SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Input-to-Output Isolation		Non-isolated		Vdc	
Input-to-Case Isolation	2500			Vdc	
Output-to-Case Isolation	2500			Vdc	
Circuit-to-Case Capacitance		10		nF	

THERMAL/ MECHANICAL SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Thermal Shutdown Temperature	100	105	110	°C	Baseplate temperature
Thermal Shutdown Restart Temperature		90		°C	Baseplate temperature
Thermal Resistance, Case to Ambient		6.6		°C/W	Natural Convection in Free Air, No Heatsink, Tc = 100°C

Size	**2.40 x 2.30 x 0.50**	**inch**	**1/2 Brick**
Weight	**4.2**	**oz.**	

EMC COMPLIANCE	**EXTERNAL FILTER**	**COMPLIANCE**
RTCA DO-160	**ASTRODYNE PN: FA250-5**	**RTCA DO-160 Section 21.3 Categories L and M**

RELIABILITY	**MINIMUM**	**TYPICAL**	**MAXIMUM**	**UNITS**	**CONDITIONS**
MTBF Prediction		**2.0**		**M hrs**	**MIL-217F GB 25°C**

PIN FUNCTION/DESCRIPTION

AC1, AC2

These are the AC input terminals. The input should be connected to a suitable filter such as the F250-5 in order for the PFC module to perform properly and to comply with applicable EMI/EMC performance standards. A suitable fuse and inrush limiting thermistor should be connected in series with the input as well.

+Out

This is the positive output terminal. It should be connected to the positive terminal of the bulk capacitor. The 375 VDC output will appear here with respect to the – Out terminal. The hold-up capacitor value ranges are provided in the specifications.

-Out

This is the PFC negative output terminal. It should be connected directly to the negative terminal of the hold up capacitor. The hold-up capacitor must be located in close proximity to the PFC output terminals.

LD ENA

This terminal provides logic control to downstream DC/DC converters. The LD ENA signal will be an active low signal until the PFC output voltage reaches a specified value after the application of input voltage. It will switch logic state to open collector upon the PFC output reaching 340 Vdc. If AC power is lost or removed, the LD ENA will return to the low state when the PFC output drops to 220 Vdc. For most RO DC-DC products, it is not necessary to use the LD ENA terminal.

V AUX (Option A)

This terminal provides an "always on" 12.5V pull up capable of providing 3mA. The V AUX supply voltage is derived from the output and will be present as long as the bulk cap voltage remains above 180V.

APPLICATION DIAGRAM

The connection diagram below shows proper connections of the PFC-375 module to a typical application circuit including fuse, filter, bulk capacitor and inrush limiting thermistor.

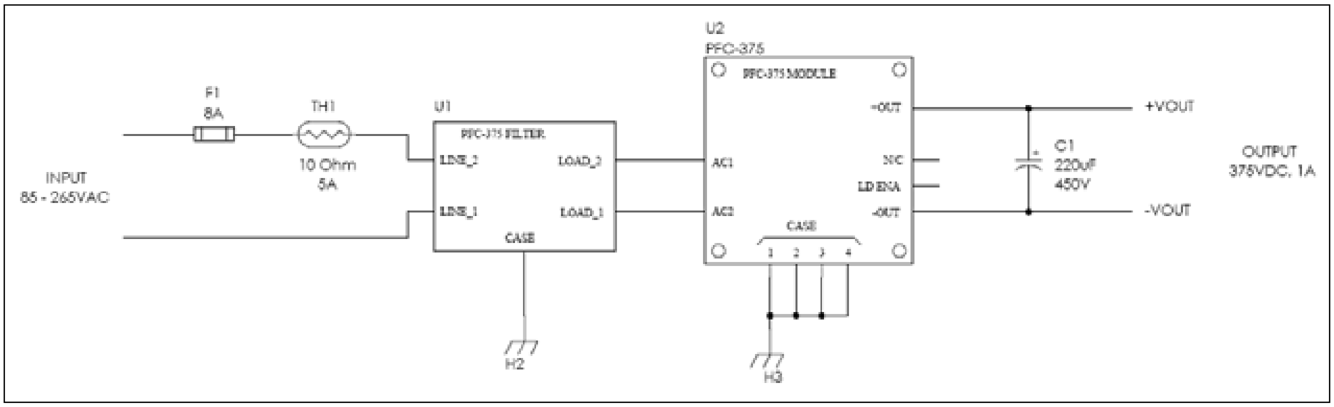


Figure 1 – Typical Application Circuit

The output is suitable for driving 300V input DC-DC converters up to 300W such as the uV300-164 Series products.

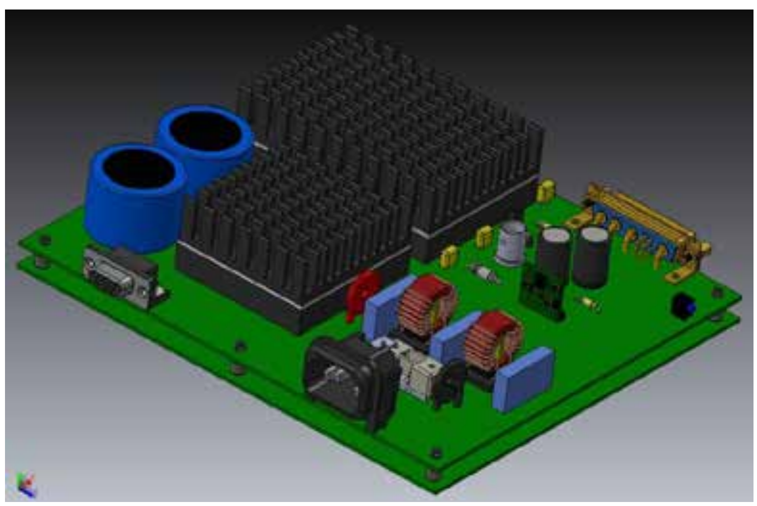
Additional applications information is available to assist in the selection of the external components.

EVALUATION BOARD

An Evaluation Board is available that demonstrates a complete AC-DC system using the PFC-375, FA250-5 filter and uV300-164 300W DC-DC converter.

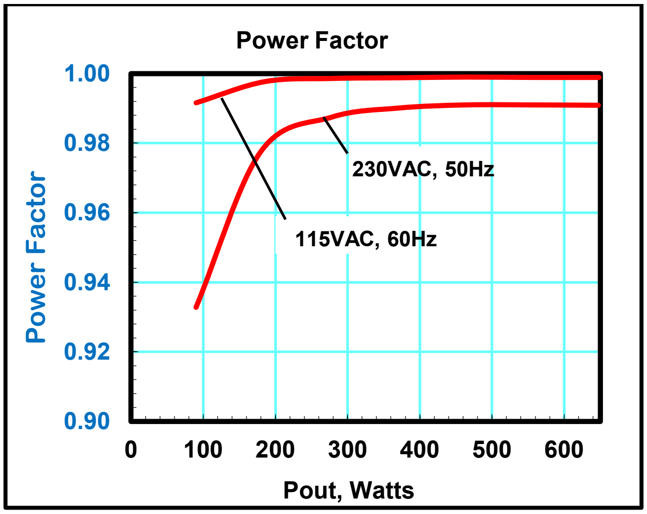
Evaluation board features :

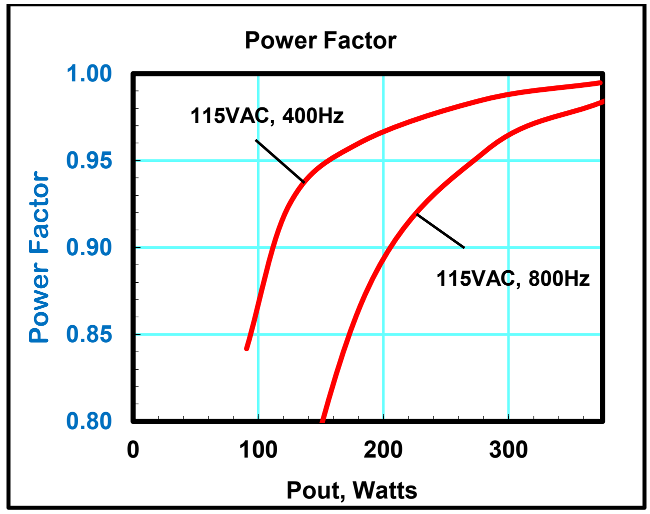
- PFC Output pinned out to 9 pin D-sub
- Series or Parallel Bulk Cap connections provided
- DC-DC has remote Sense capability – jumpers included, sense pinned out
- LED for low voltage DC Output indication included
- Test points for DC-DC Output measurement included
- BNC Connector for DC-DC ripple measurement included
- Vaux pinned out on EB
- Provision for current sharing and 3 phase operation

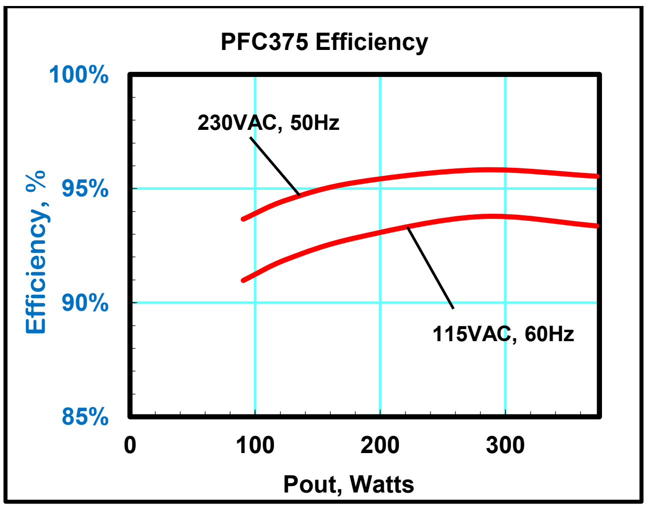


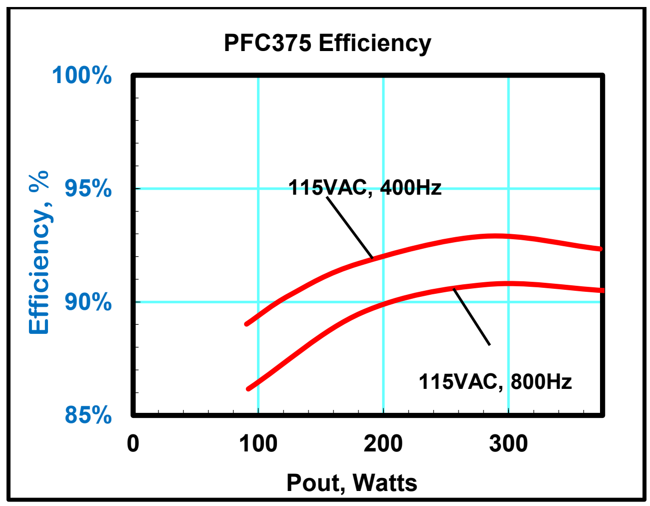
PFC-375 Series

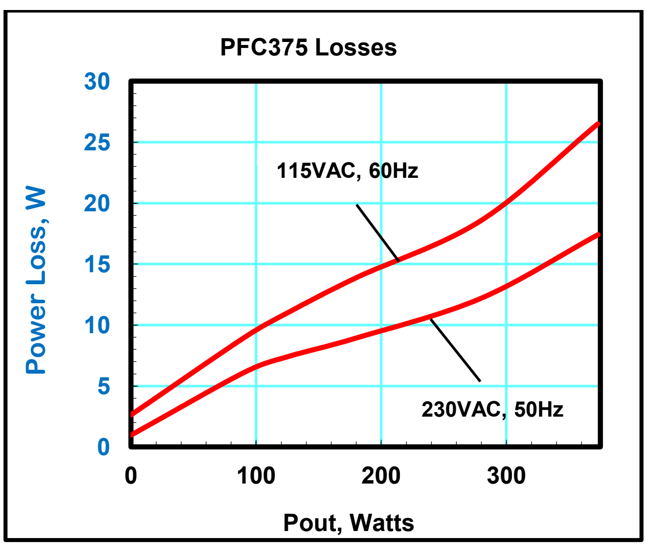
375 Watt Power Factor Correction Module
375 VDC Output, ½ Brick Package

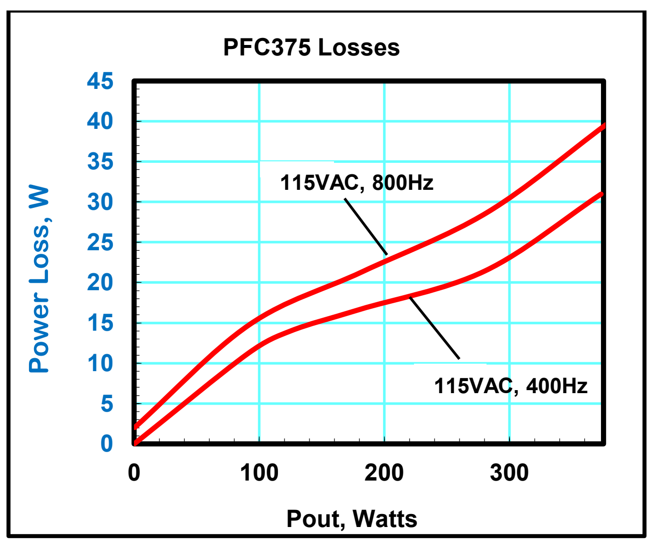




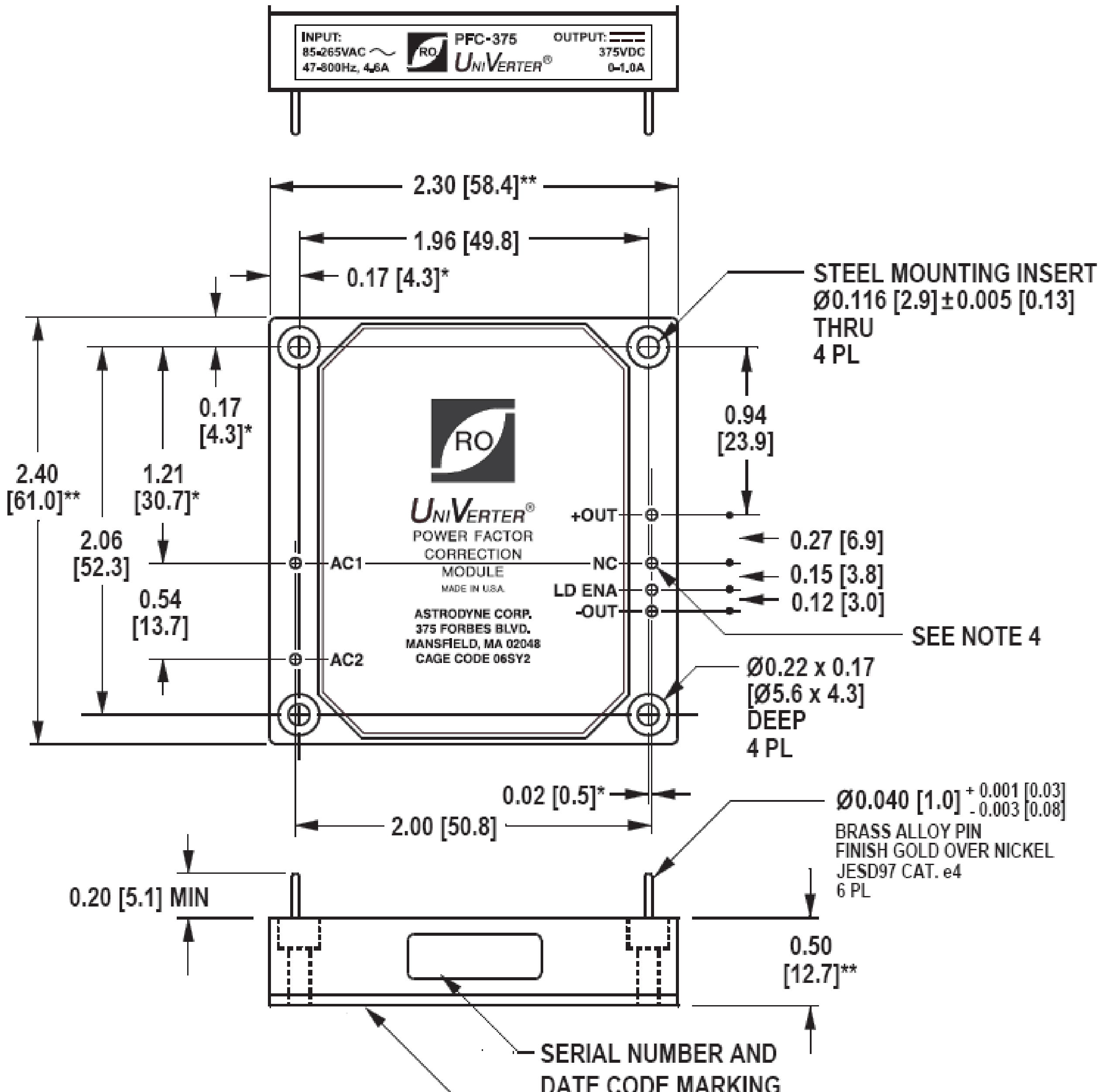








MECHANICAL DRAWING



NOTES:

1. Projection is third angle.
2. All dimensions in inches [mm].
3. Tolerance:
   a. Tolerance on all dimensions unless specified otherwise: ±0.01 [0.25].
   b. Tolerance on all dimensions marked with *: ±0.015 [0.4].
   c. Tolerance on all dimensions marked with **: ±0.02 [0.5].
4. VAUX when "A" option is ordered. Otherwise not connected.

Astrodyne
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PFC-650 Series
Univerter® Power Factor Correction Module

650 Watt PFC Front End

The Univerter PFC-650 Power Factor Correction modules are AC to DC converters that operate from wide range AC input voltages and frequencies with extremely high conversion efficiency and near unity power factor, producing an output of 375VDC. The PFC-650U operates from the universal input voltage range of 90 to 265VAC and input frequencies in the range of 47 to 440Hz making it ideal for applications requiring Power Factor Correction the world over. Model PFC-650W is optimized for input voltages in the 90 to 180VAC range and input frequencies in the range of 330 to 880Hz making it an ideal choice for both military and commercial aircraft applications. These compact power modules use advanced electrical design and thermal management techniques that make them suitable for rugged, environmentally challenged applications.

Compact ¾ Brick Package
3.6 x 2.4 x 0.5 in.

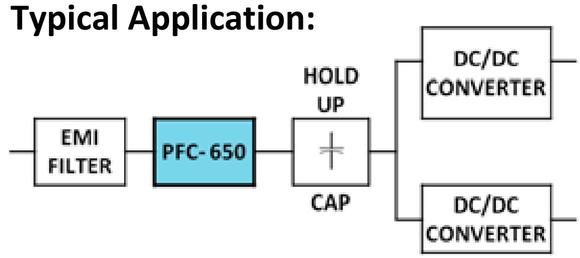
FEATURES

- Extremely High Efficiency – 94% typ
- Near Unity Power Factor – 0.99 typ.
- High Power Density – 150W/in³
- -40ºC to +100 ºC Operation Standard
- -55ºC to +100 ºC Operation Optional
- Extremely Low Thermal Resistance
- Conduction Cooled
  Rugged Encapsulated Package
- Active Inrush Current Limiting
- LD ENA Signal Controls Downstream Converters
- MIL-STD-704/DO-160 Compatible

MODEL SELECTION

MODEL	Input Voltage, VAC	Input Frequency, Hz
PFC-650U	90 - 265	47 - 440
PFC-650W	90 - 180	330 - 880

Typical Application:



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Now you have power.

Astrodyne USA: 1-800-823-8082
Astrodyne Pacific: 886-2-26983458

650 Watt Power Factor Correction Module
375 VDC Output, ¾ Brick Package

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability					
PARAMETER	**OPTION**	**MINIMUM**	**MAXIMUM**	**UNITS**	**CONDITIONS**
Input Voltage (AC1 to AC2)			265	VAC	Continuous
Input Voltage (AC1 to AC2)			311	VAC	100ms max.
LD ENA Voltage (LD ENA to -Vout)		-0.3	15.0	Vdc	
Circuit-to-Case Voltage			2500	Vdc	
Storage Temperature	Standard	-55	110	°C	
	T	-55	110	°C	
	E	-55	125	°C	
Operating Temperature	Standard	-40	100	°C	Baseplate
	T	-55	100	°C	Baseplate
	E	-55	125	°C	Baseplate
Soldering Temperature			260	°C	< 5 sec

SPECIFICATIONS
Electrical specifications apply for Vin = 115VAC, 60Hz (400Hz for PFC-650W model) Full Load, Tc=25 °C unless specified otherwise

INPUT SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Input Voltage					
PFC-650U	90	115/230	265	VAC	
PFC-650W	90	115	180	VAC	
Input Line Frequency					
PFC-650U	47	50/60/400	440	Hz	
PFC-650W	330	400/600	880	Hz	
Power Factor					
PFC-650U		0.999			Vin = 115VAC, 60 Hz, Full Load
PFC-650U		0.990			Vin = 230VAC, 50 Hz, Full Load
PFC-650W		0.980			Vin =115VAC, 400 Hz, Full Load

SPECIFICATIONS (continued)

Electrical specifications apply for Vin = 115VAC, 60Hz (400Hz for PFC-650W model) Full Load, Tc=25 °C unless specified otherwise

Maximum Input Current		8.1		Arms	Vin = 90VAC, Full Load, Tc = 25°C
			6.2	Arms	Vin = 115VAC, Tc = 100°C
Inrush Current					
PFC-650U		25			Using 15Ω external Rss.
PFC-650W		10		A	115VAC, 400Hz
Start-up Voltage	70	80	85	VAC	
Input Under Voltage	65	75	85	VAC	
Ride Through Time 1		75		mS	Vin = 115VAC, 60 Hz, Half Load, C hold up = 440uF. Note: Ride through is indefinite if output is held above 250 VDC.
Ride Through Time 2		150		mS	Vin = 115VAC, 60 Hz, Half Load, C hold up = 880uF. Note: Ride through is indefinite if output is held above 250 VDC.

OUTPUT SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Output Voltage	370	375	380	Vdc	Vin = 115VAC, Tc = 25°C
Output Current	0		1.75	ADC	
Output Current Limit		NONE			
Ripple					
PFC-650U		30		V p-p	Vin = 115VAC, 60Hz, C hold up = 440uF
PFC-650W		30		V p-p	Vin = 115VAC, 400Hz, C hold up = 136uF
Hold Up Capacitance					
PFC-650U	220		1000	µF	
PFC-650W	40		220	µF	
Efficiency					
PFC-650U		0.990			Vin = 115VAC, 60 Hz, Full Load
PFC-650U		0.999			Vin = 230VAC, 50 Hz, Full Load
PFC-650W		0.94			Vin =115VAC, 400 Hz, Full Load

PFC-650 Series

650 Watt Power Factor Correction Module
375 VDC Output, ¾ Brick Package

SPECIFICATIONS (continued)

Electrical specifications apply for Vin = 115VAC, 60Hz (400Hz for PFC-650W model) Full Load, Tc=25 °C unless specified otherwise

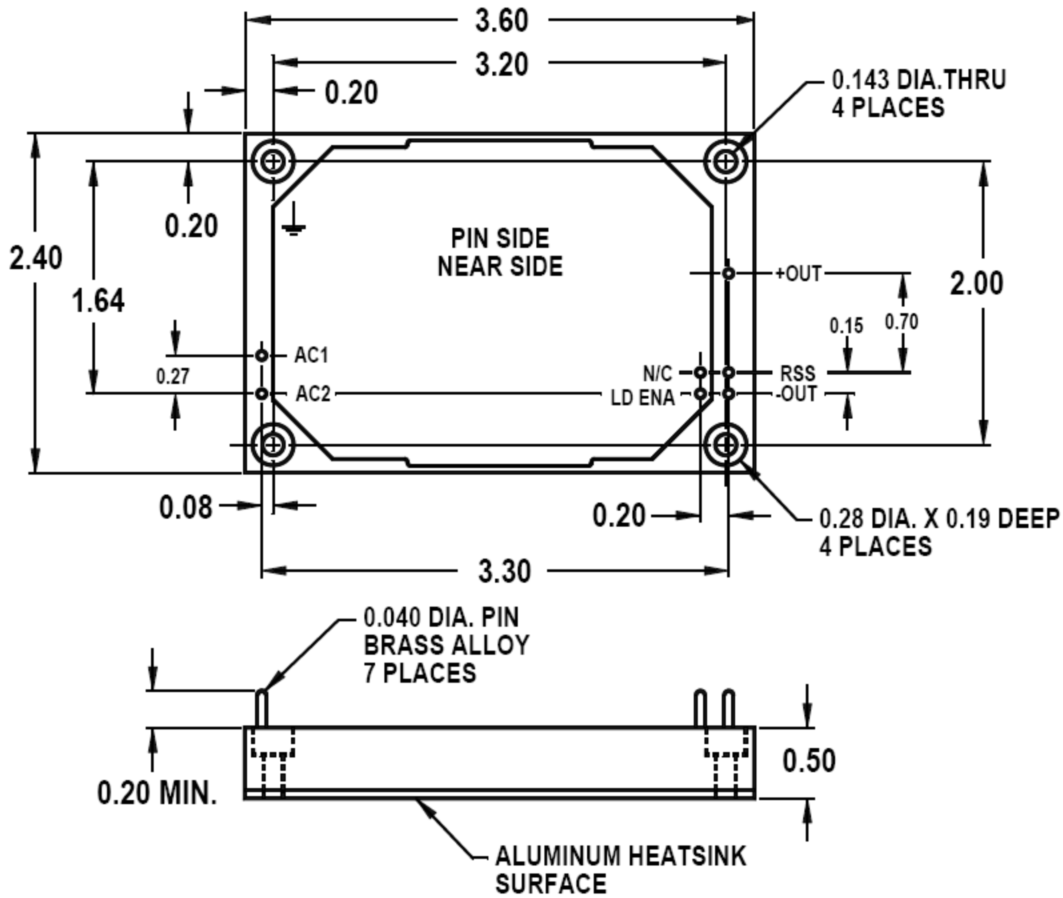
CONTROL SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
LD ENA Threshold (Vout rising)	320		360	Vdc	
LD ENA threshold (Vout falling)	205		235	Vdc	
LD ENA Logic Low Current			20	mA	
LD ENA Logic Low Voltage			0.5	Vdc	LD ENA LOGIC LOW SINK CURRENT = 10mA

ISOLATION SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Input-to-Output Isolation		Non-isolated		Vdc	
Input-to-Case Isolation	2500			Vdc	
Output-to-Case Isolation	2500			Vdc	
Circuit-to-Case Capacitance		10		nF	

THERMAL/ MECHANICAL SPECIFICATIONS	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
Thermal Shutdown Temperature		105		°C	Baseplate temp
Thermal Shutdown Restart Temperature		85		°C	Baseplate temp
Thermal Resistance, Case to Ambient		4.2		°C/W	Natural Convection in Free Air, No Heatsink, Tc = 100°C
Size, l x w x h		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (gm)	

EMC COMPLIANCE	EXTERNAL FILTER	COMPLIANCE
MIL-STD-461E	FA250-6	YES

RELIABILITY	MINIMUM	TYPICAL	MAXIMUM	UNITS	CONDITIONS
MTBF Prediction		1.8		M hrs	MIL-217F GB 25°C



Outline Drawing

Pin Function/Description

AC1, AC2

These are the AC input terminals. The input should be connected to a suitable input filter in order to for the PFC module to perform properly and reliably and to comply with applicable EMI performance standards.

+Out

This is the positive output terminal. It should be connected to the positive terminal of the hold up capacitor. The 375 VDC output will appear here w.r.t the –Out terminal. Hold-up capacitor value ranges are provided in the specifications. The hold-up capacitor must be located in close proximity to the PFC output terminals.

LD ENA

This terminal provides logic control to downstream DC/DC converters. The LD ENA signal will be a logic low during PFC start up and will switch logic state (to open collector) upon the PFC output reaching 340 VDC. If AC input power is lost, the LD ENA will again go low when the PFC output drops to 220 VDC. For many RO DC/DC products, it is not necessary to use the LD ENA terminal. Please see the applications notes or consult the factory for more information.

RSS

This terminal is internally connected to inrush control circuitry on model PFC-650U and is N/C on model PFC-650W. Model PFC-650W has a built in inrush limiting resistor whereas for model PFC-650U the resistor must be provided externally. For PFC-650U, connect one end of the inrush limiting resistor to this terminal. The other end of the resistor will be connected to –Out. The external inrush resistor must be chosen to handle the inrush energy which is determined by the input voltage and hold-up capacitor value selected. The inrush connection diagram provides some specific recommendations. Consult the factory for assistance or additional information on selecting an inrush resistor.

-Out

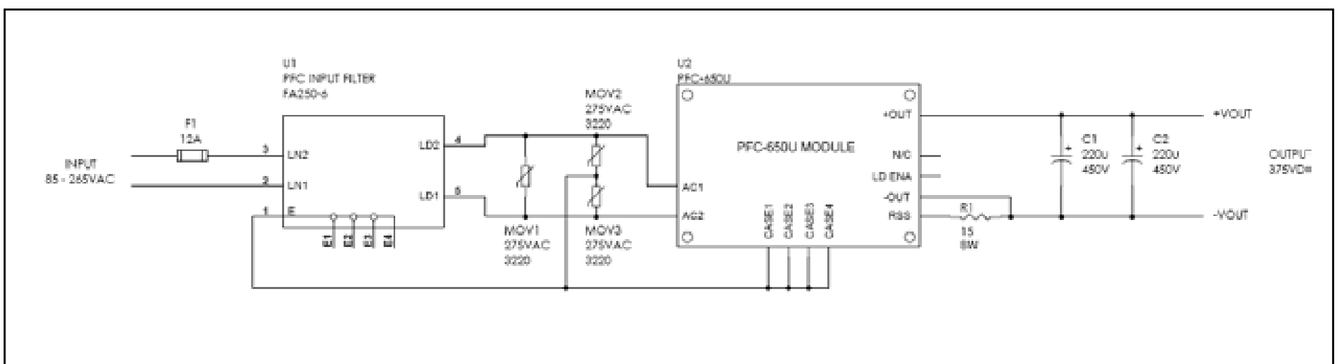
This is the PFC negative output terminal. It should be connected to the negative terminal of the hold up capacitor. For model PFC-650U, connect one end of the inrush resistor to this terminal.

Application Diagram

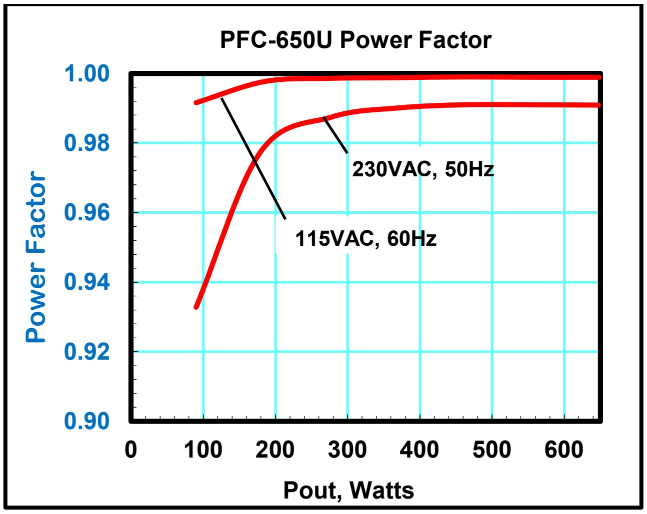
The connection diagram below shows proper connections between PFC-650 modules, hold-up capacitor, inrush limiting resistor (if required) and DC/DC converters.

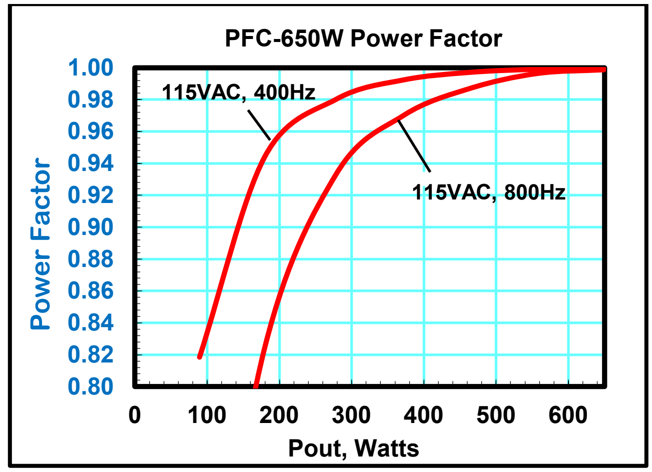
For PFC-650W, the inrush limiting resistor is built-in and an external resistor is not required. The resistor is appropriately sized for a maximum input voltage of 180VAC and a maximum external hold-up capacitor value of 220uF.

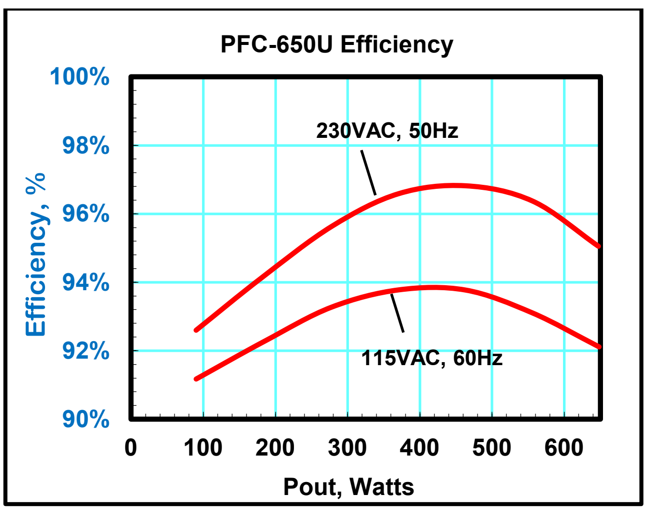
For PFC-650U, an external inrush limiting resistor must be provided and connected as shown in the connection diagram for PFC-650U. A resistor with high surge handling capability should be used. The maximum input voltage, external hold-up capacitor value and temperature must be considered in choosing a resistor. The maximum RMS input voltage and resistor value will determine the maximum inrush current. A resistor value between 10 and 20 ohms should be chosen. The surge energy in the resistor is that required to charge the hold-up capacitor up to the peak of the line. After that, internal circuitry will both bypass the external resistor with essentially a short circuit and limit additional inrush current.

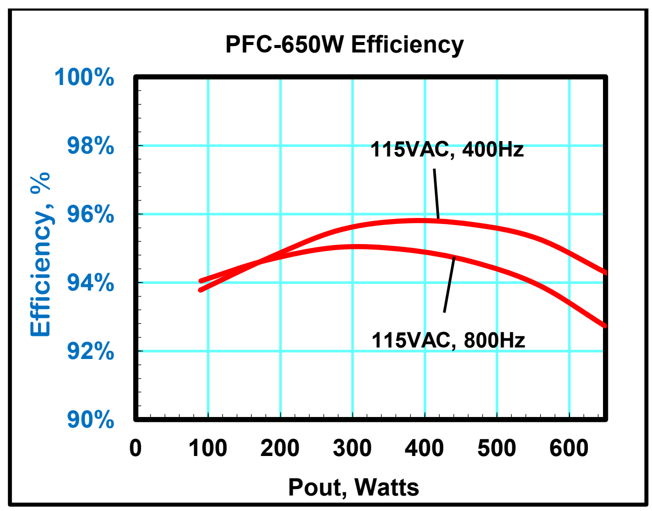


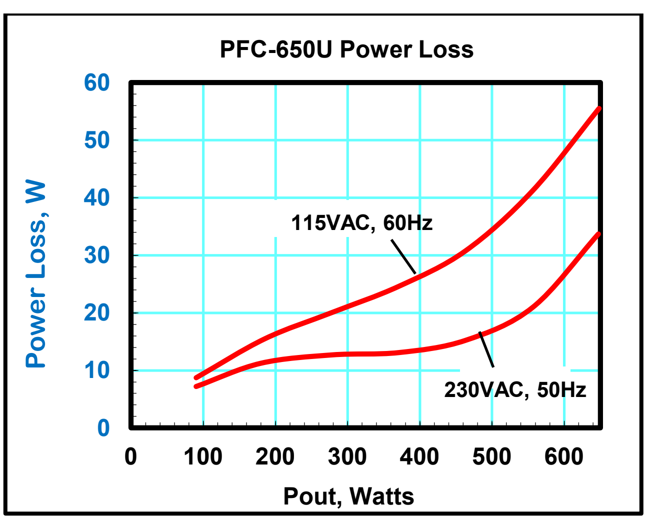
Connection Diagram for PFC-650U

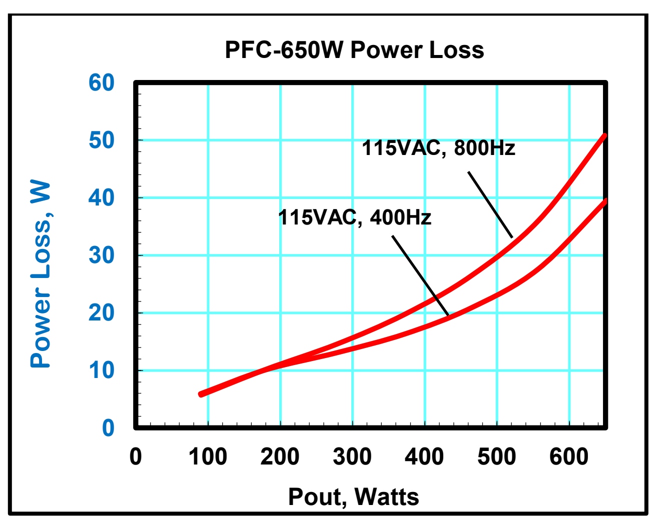

PFC-650U Power Factor
Power Factor
1.00
0.98
0.96
0.94
0.92
0.90
0
100
200
300
400
500
600
Pout, Watts
230VAC, 50Hz
115VAC, 60Hz


PFC-650W Power Factor
Power Factor
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
0.82
0.80
0
100
200
300
400
500
600
Pout, Watts
115VAC, 400Hz
115VAC, 800Hz


PFC-650U Efficiency
Efficiency, %
100%
98%
96%
94%
92%
90%
0
100
200
300
400
500
600
Pout, Watts
230VAC, 50Hz
115VAC, 60Hz


PFC-650W Efficiency
Efficiency, %
100%
98%
96%
94%
92%
90%
0
100
200
300
400
500
600
Pout, Watts
115VAC, 400Hz
115VAC, 800Hz


PFC-650U Power Loss
Power Loss, W
60
50
40
30
20
10
0
0
100
200
300
400
500
600
Pout, Watts
115VAC, 60Hz
230VAC, 50Hz


PFC-650W Power Loss
Power Loss, W
60
50
40
30
20
10
0
0
100
200
300
400
500
600
Pout, Watts
115VAC, 800Hz
115VAC, 400Hz

PFC UNIVERTER® SERIES

375-1000 WATTS 85-265VAC INPUT 3/4" & FULL BRICK POWER FACTOR

DESCRIPTION

UniVerter PFC modules accept 85-265 VAC (PFC-600, PFC-650) or 170-265 VAC (PFC-1000)& convert it to 380 VDC to power 300VDC input DC-DC converters. Power factor correction meets low harmonic distortion requirements of IEC 1000-3-2 and the European EN55022 emissions specification when used with the Model HH-1199-6 EMI filter. UniVerter modules utilize a boost converter incorporating a solid state series switch for active inrush and short circuit current limiting. The series switch is also used to provide over temperature shutdown with automatic recovery.

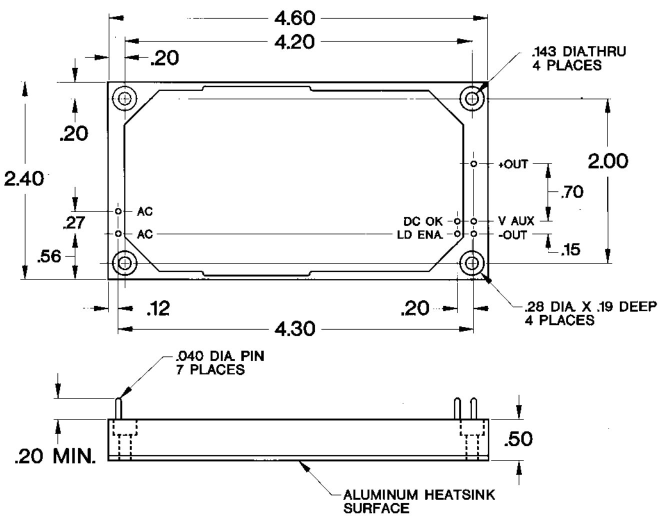
FEATURES

- 600, 650 & 1000 Watts
- UL/CSA/TUV/CE MARK
- Meets European EN55022 Emissions when used with HH-1199-6 EMI Filter
- Unity Power Factor
- High Efficiency
- Active Inrush Limiting and Short Circuit Protection
- Very Low Harmonic Distortion
- Auxiliary Supply
- Power Fail Warning Via DC OK Signal
- Load Enable Signal to Control DC-DC Converters
- Very Low Thermal Resistance
- Superior Thermal Design
- 100°C Baseplate Operation

MODEL SELECTION

Model Number	Input Voltage	Output Voltage	Output Power*
PFC-600	85-265VAC	380VDC	600 Watts
PFC-650	85-265VAC	375VDC	650 Watts
PFC-1000	170-265VAC	380VDC	1000 Watts

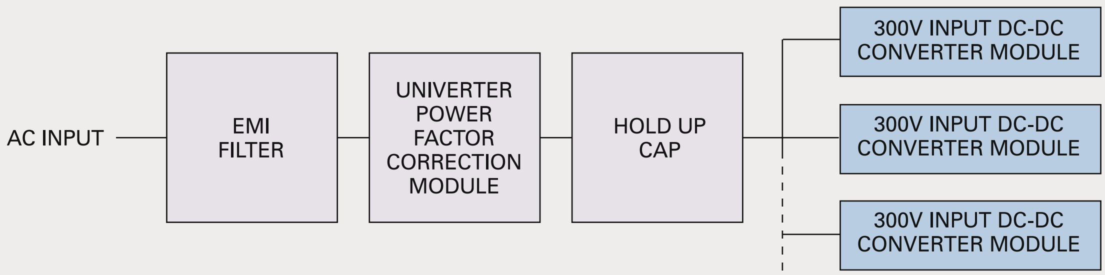
* See Derating Specification



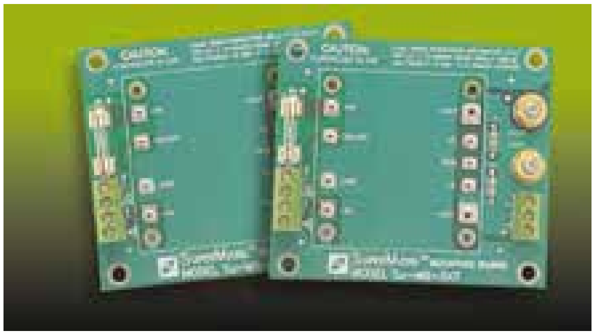
PFC UNIVERTER SERIES SPECIFICATIONS

	PFC-600	PFC-1000
Power (Watts)	600 W	1000 W
	Derate output power linearly below 105 VAC from 600W at 105 VAC to 400W at 85 VAC	Derate output power linearly below 205 VAC from 1000W at 205 VAC to 750W at 170 VAC
Input Range	85-265 VAC	170-265 VAC
Input Frequency	47-63 Hz (operation up to 440Hz is available with reduced specifications)	47-63 Hz (operation up to 440Hz is available with reduced specifications)
Power Factor	.99	.99
Harmonic Distortion	<5% (conforming to IEC 1000-3-2)	<5% (conforming to IEC 1000-3-2)
Output Voltage	380 VDC	380 VDC
Efficiency *See Curves on Page 79*	90/94 % (120/240 VAC) typical	94 % (240 VAC input)
Inrush Limiting	<15 A peak typical	30 A (max)
Short Circuit Protection	Trip point 1.8 A (Shutdown, automatic recovery after removal of short)	2.8 A (Shutdown, automatic recovery after removal of short)
Thermal Protection	105-110°C (Shutdown, automatic recovery)	105-110°C (Shutdown, automatic recovery)
Auxiliary Supply	14 V @ 10 mA	14 V, @10 mA
DC OK Signal	Provides power fail warning when output drops below 355VDC	Provides power fail warning when output drops below 355VDC
Load Enable	Direct interface with MicroVerter, MegaVerter and PicoVerter DC-DC Converter logic on/off pin	Direct interface with MicroVerter MegaVerter and PicoVerter DC-DC Converter logic on/off pin
Operating Temp.	-40 to +100°C Case	-40 to +100°C Case
Overvoltage Protection	415 VDC non-shutdown	415 VDC non-shutdown
Safety	UL1950, CSA22.2-234-M90, EN 60950	UL1950, CSA22.2-234-M90, EN 60950
Thermal Resistance (Case To Ambient)	3.3°C/W	3.3°C/W
Isolation: Input-Output	Non-isolated	Non-isolated
Input/Output-Case	2500 VDC	2500 VDC

SYSTEM DIAGRAM



MOUNTING BOARDS



DESCRIPTION

RO Mounting Boards provide an off-the-shelf solution to convert PC mount pins to chassis mount terminal strips. The ready to use PC boards contain many user features. The Mounting Boards are perfect for prototypes and other low volume applications.

FEATURES

- Conversion From Pins To Wire Terminals
- Instant PC Design
- Large Stud Terminals For High Current Output
- Ground Plane To Shield Noise
- Remote Sense Jumpers (DC-DC Models)
- Fuse Protection
- Plated Through Holes
- 4 Through Holes For Customized Mounting
- 4 Standoffs To Mate With Converters
- Solder or Socket Mount

BOARD SELECTION

Mounting Board	Module
Single Output MicroVerter:	
MB-S*	uV28 or uV48 Single
MB300-S*	uV300 Single
Triple Output MicroVerter:	
MB-T*	uV28 or uV48 Triple
MB300-T*	uV300 Triple
NanoVerter and PicoVerter:	
nV-MB*	nV48
nV300-MB*	nV300
pV-MB*	pV48
pV300-MB*	pV300
Single Output SuperVerter:	
SV-MB*	sV28 or sV48 Single
PFC-600 & PFC-1000:	
MB-PFC-SKT	PFC-600 or PFC-1000

**Add suffix - SKT for optional sockets.*

SINGLE OUTPUT MICROVERTER BOARDS

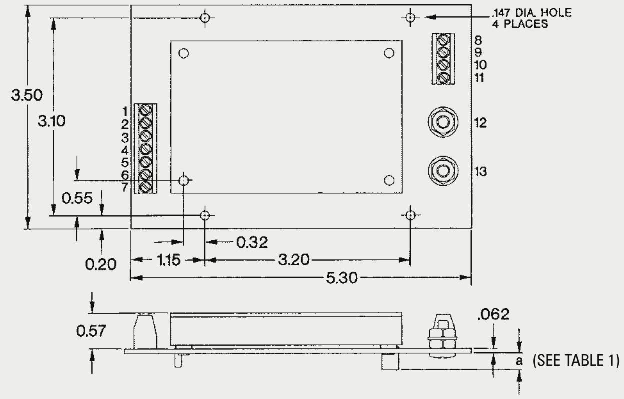


TABLE 1: Dimension "A" Values

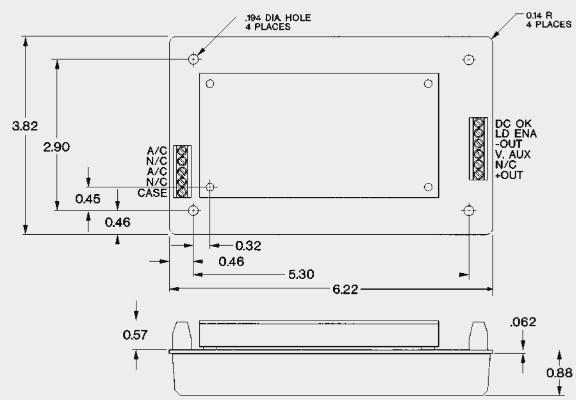
Model	*Diameter "A"*
MB-S	0.10
MB-S-SKT	0.26
MB300-S	0.10
MB300-S-SKT	0.26

TABLE 2: Terminal Assignments

Terminal	*MB-S*	*MB300-S*
1	+V In	+V In
2	Parallel On/Off	N/C
3	-V In	Parallel On/Off
4	Optional Sync	-V In
5	Case	Optional Sync
6	Not Provided	N/C
7	Not Provided	Case
8	Output Good	Output Good
9	-Sense	-Sense
10	Trim	Trim
11	+Sense	+Sense
12	+V Out	+V Out
13	-V Out	-V Out

Note: -SKT models have the same pin-outs as corresponding non-SKT models.

PFC-600 AND PFC-1000 BOARDS



SINGLE OUTPUT SUPERVERTER BOARDS

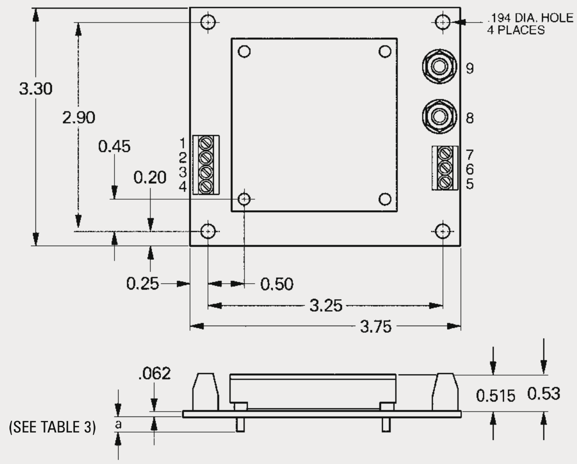
TABLE 2: Dimension "A" Values

Model	*Dia. "A"*
SV-MB	0.16
SV-MB-SKT	0.32

TABLE 3: Terminal Assignments

Terminal	*SV-MB*
1	+V In
2	On/Off
3	-V In
4	Case
5	-S
6	T
7	+S
8	-V Out
9	+V Out

Note: -SKT models have the same pin-outs as corresponding non-SKT models.



TRIPLE OUTPUT MICROVERTER BOARDS

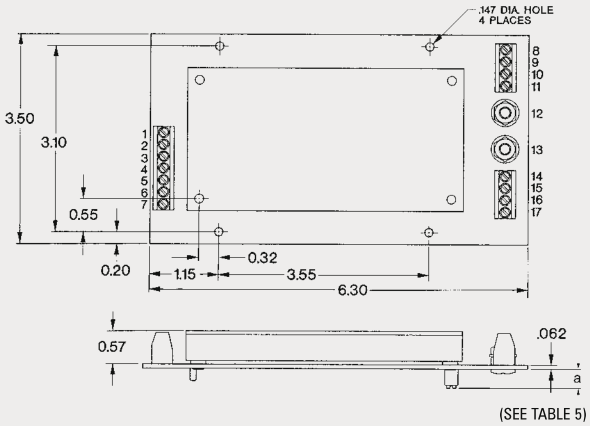


TABLE 5: Dimension "A" Values

Model	*Diameter "A"*
MB-T	0.10
MB-T-SKT	0.32
MB300-T	0.10
MB300-T-SKT	0.32

TABLE 6: Terminal Assignments

Terminal	*MB-T*	*MB300-T*
1	+V In	+V In
2	Parallel On/Off	N/C
3	-V In	Parallel On/Off
4	Optional Sync	-V In
5	Case	Optional Sync
6	Not Provided	N/C
7	Not Provided	Case
8	Output Good	Output Good
9	-Sense	-Sense
10	Trim	Trim
11	+Sense	+Sense
12	+Output V1	+Output V1
13	-Output V1	-Output V1
14	-Output V2	-Output V2
15	+Output V2	+Output V2
16	-Output V3	-Output V3
17	+Output V3	+Output V3

Note: -SKT models have the same pin-outs as corresponding non-SKT models.

NANOVERTER AND PICOVERTER BOARDS

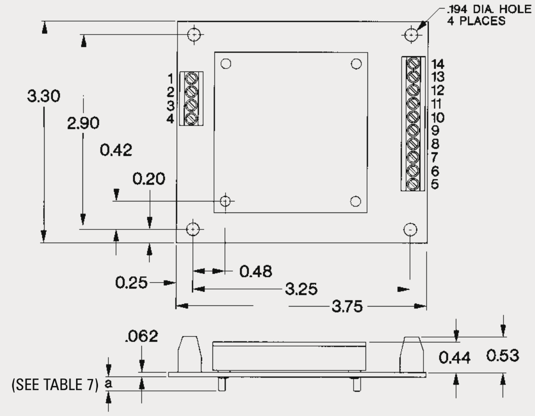


TABLE 7: Dimension "A" Values

Model	*Diameter "A"*
NV-MB	0.15
NV-MB-SKT	0.22
NV300-MB	0.15
NV300-MB-SKT	0.22
PV-MB	0.15
PV-MB-SKT	0.32
PV300-MB	0.15
PV300-MB-SKT	0.32

TABLE 8: Terminal Assignments

Terminal	*NV-MB*	*NV300-MB*	*PV-MB/PV300-MB*
1	Not Provided	Case	+V In
2	Case	N/C	On/Off
3	-V In	-V In	-V In
4	+V In	+V In	Case
5	+V Out	+V Out	-Out
6	+V Out	+V Out	-Out
7	-V Out	-V Out	-Sense
8	-V Out	-V Out	Trim
9	On/Off	On/Off	+Sense
10	Trim	Trim	+Out
11	+Sense	+Sense	+Out
12	-Sense	-Sense	Not Provided
13	Parallel	Share	Not Provided
14	PV	Not Provided	Not Provided

Note: -SKT models have the same pin-outs as corresponding non-SKT models.

EMI FILTER

MODEL HH-1199-6 250 VAC 6A

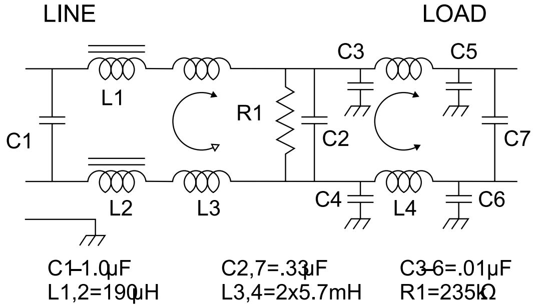
DESCRIPTION

The HH-1199-6 filter has been designed especially for the UniVerter Series of AC-DC converters with Power Factor Correction. This filter works well to meet the new European EN55022 emissions speci fication or for systems required to meet the FCC conducted emissions standards.

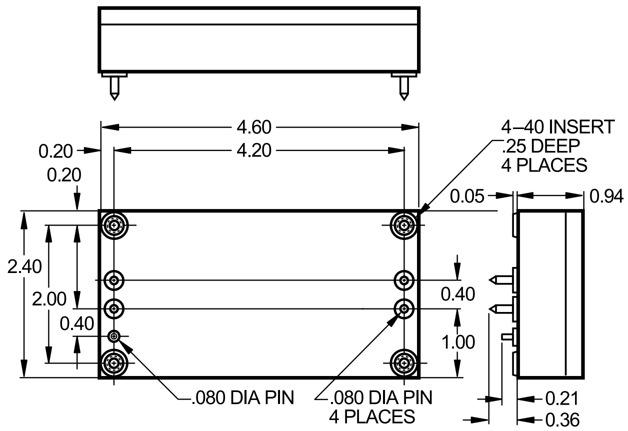
SPECIFICATIONS

Operating Voltage	125/250 VAC
Operating Current (max)	6.0 A
Frequency	50 / 60 Hz
Temperature Range (storage)	-40 to 85 °C
Temperature Range (operating)	-20 to 50 °C
Diel. Withstanding Voltage (ph-case)	1500 VAC
Diel. Withstanding Voltage (ph-ph)	1500 VDC
Leakage Current at 250 VAC, 60 Hz	2.5 mA max
Discharge Voltage After 60 Seconds	34 V max

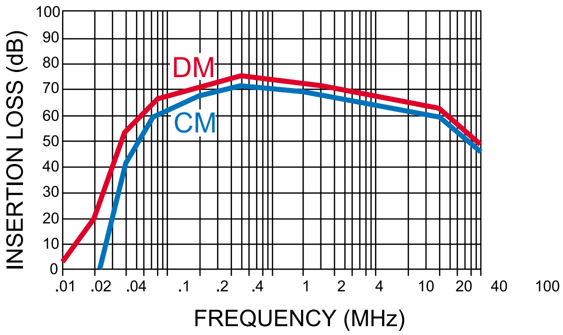
CIRCUIT DIAGRAM



OUTLINE DIAGRAM

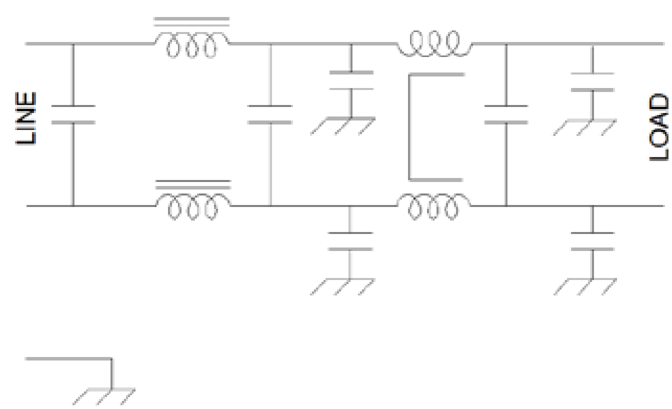


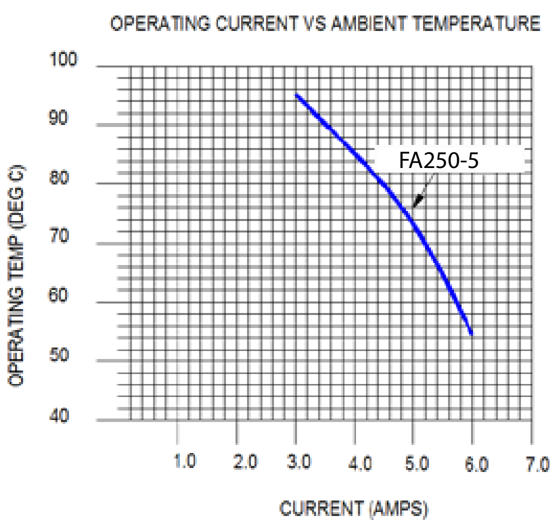
INSERTION LOSS

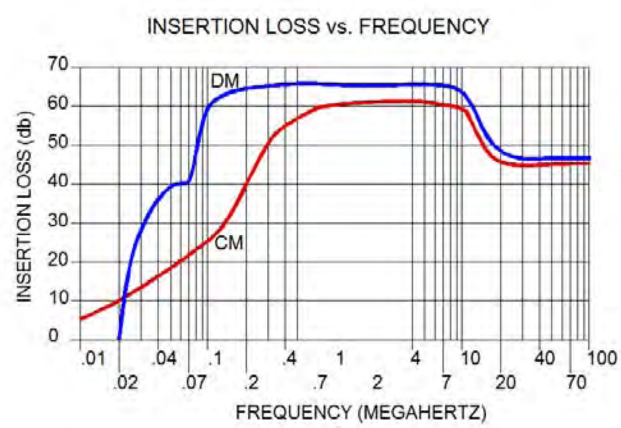


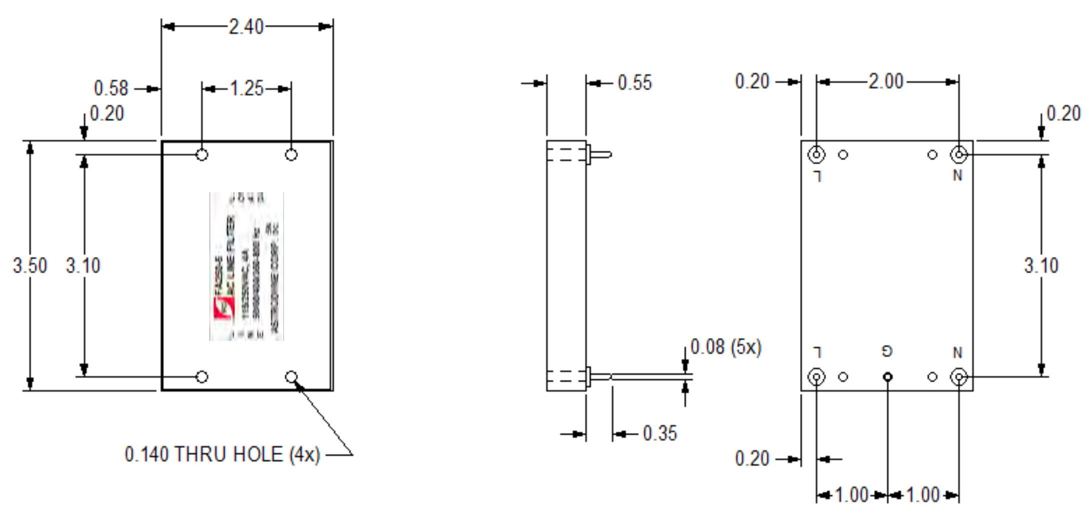
Operating voltage________________85 to 250 V~
Operating current ________________4.0 Amp
Operating frequency______________50/400 Hz
Operating temperature, High________See temp.curves
Operating temperature, Low _________-55º C,
Diel. withstanding (line - case)_______1500 Vac
Diel. withstanding (line - line)________1500 Vdc
Leakage current___________________2.0 ma @ 220 V, 60 Hz
Max residual voltage after 1 sec__ 34 Volts

The Model Number is FA250-5









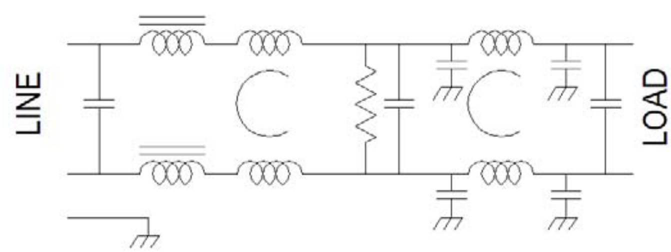
Astrodyne Corporation 375 Forbes Blvd. Mansfield, MA 02048 PH: 508 964-6300 FX: 508 339-0375
email: sales@astrodyne.com

Astrodyne

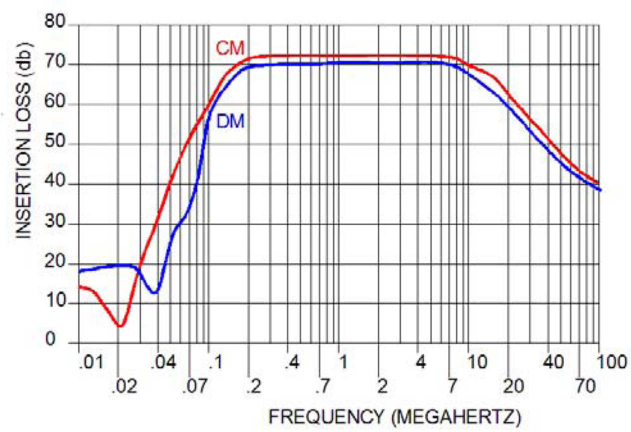
Now you have power.

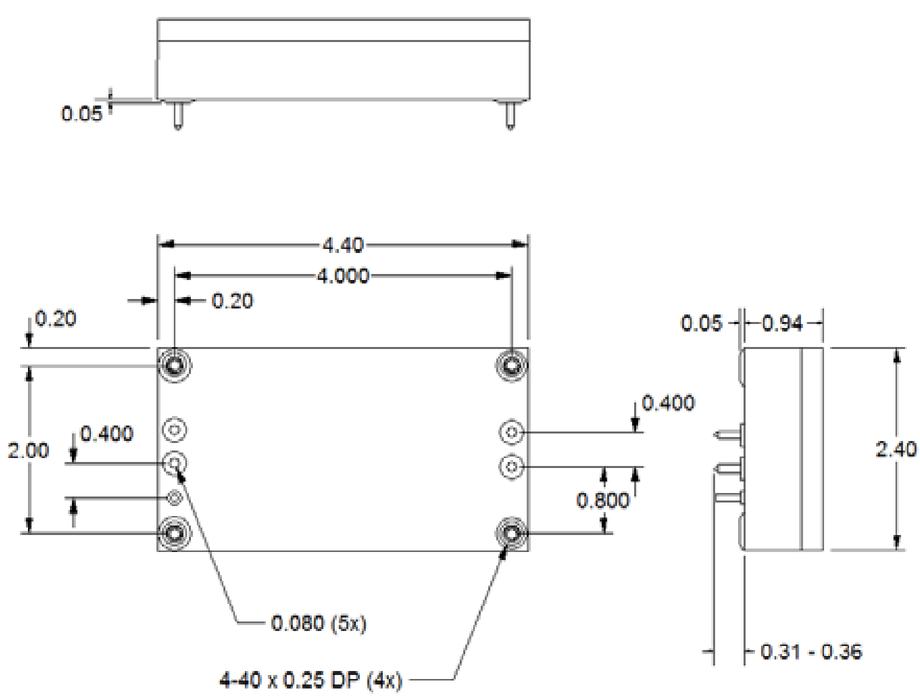
FA250-6

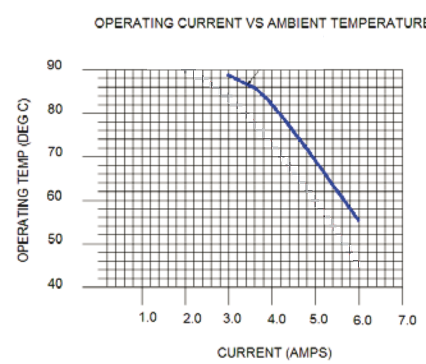
THE FA250-6 FILTER WAS SPECIFICALLY DESIGNED TO MEET THE CONDUCTED EMISSION REQUIREMENTS OF MIL-STD-461D, E OR F FROM 50HZ TO 400HZ. IT IS INTENDED FOR PRINTED CIRCUIT BOARD MOUNTING AND IS LEAD FREE AND ROHS COMPLIANT.



Operating voltage	85 to 250 V~
Operating current	6.0 Amp Max
Operating frequency	50/400 Hz
Operating temperature, High	See temp.curve
Operating temperature, Low	-40°C
Storage temperature	-40º C—100º C
Diel. withstanding (line - case)	1500 Vac
Diel. withstanding (line - line)	1500 Vdc
Leakage Current @250 Vac, 60 Hz:	2.5 ma Max.
Max residual voltage after 1 sec	34 Volts
MTBF:	13,770,311 Hrs
Weight:	1.0 lb







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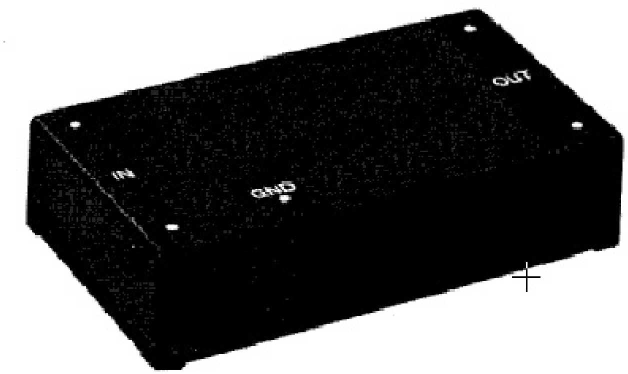
FB100-10 Filter Module

Rev 20090310a

100V, 10A
Product Data Sheet



DESCRIPTION:

The FB100-10 Filter Module is designed to reduce the conducted differential-mode and common-mode noise on input lines of DC/DC power modules. It provides high insertion loss through-out the frequency range regulated by FCC and CISPR for conducted emissions.

FEATURES:

- Minature Size: 2.00in x 1.125in x 0.50in (50.8mm x 28.6mm x 12.7mm)
- Optimized for use with RO SuperVerter fixed frequency DC to DC power modules
- Printed circuit board mountable
- Allows power modules to meed FCC and EN55022 (CISPR22)

ADDITIONAL FEATURES:

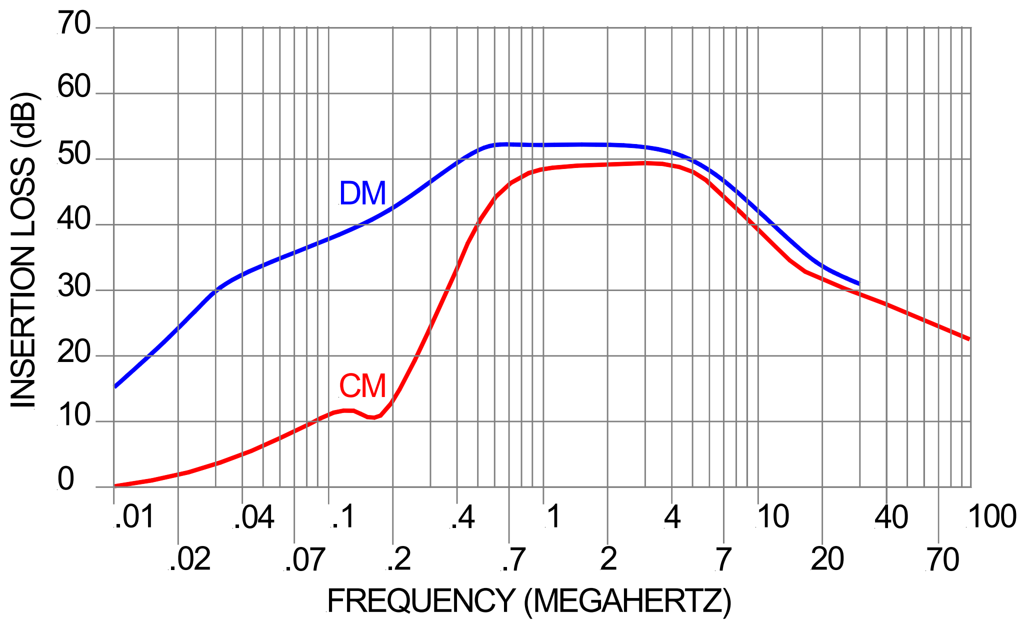
- Designed to meet UL1959; CSA C22.2 No. 950-95; VDE 0805
- Isolation voltage: 1500Vdc
- Maximum input voltage: 100V
- Operating case temperature range: -40 to 70°C
- Storage temperature: -40 to 100°C
- Calculated MTBF TBD hours at case temperature 65 degree C (Bellcore Standard).
- Short Leads: 0.23in (5.8mm)

TYPICAL CHARACTERISTECS:

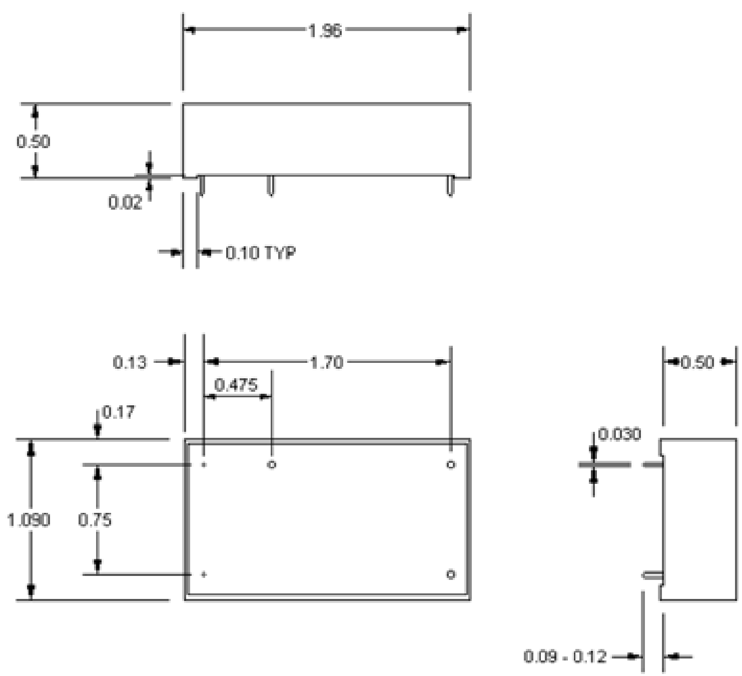
- Resistance per leg: Typ. 0.015 Ohm
- Common-mode insertion loss: 40dB at 500kHz
- Differential-mode insertion loss: 52dB at 500kHz

INSERTION LOSS

(with 50Ω source and load impedances)



OUTLINE DRAWING

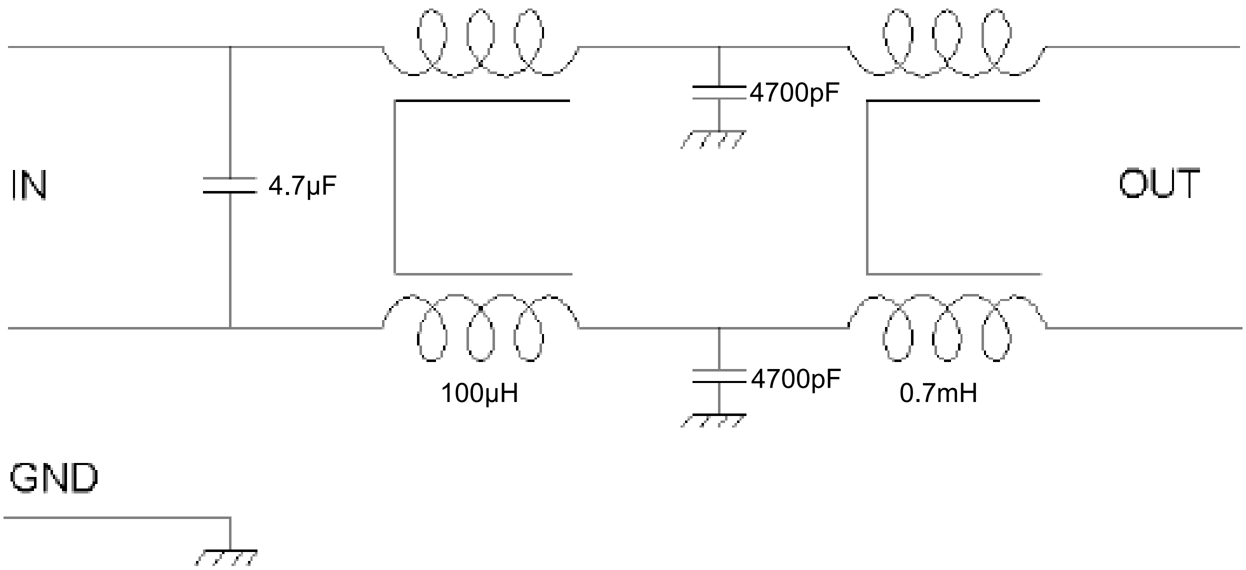


Tolerances:

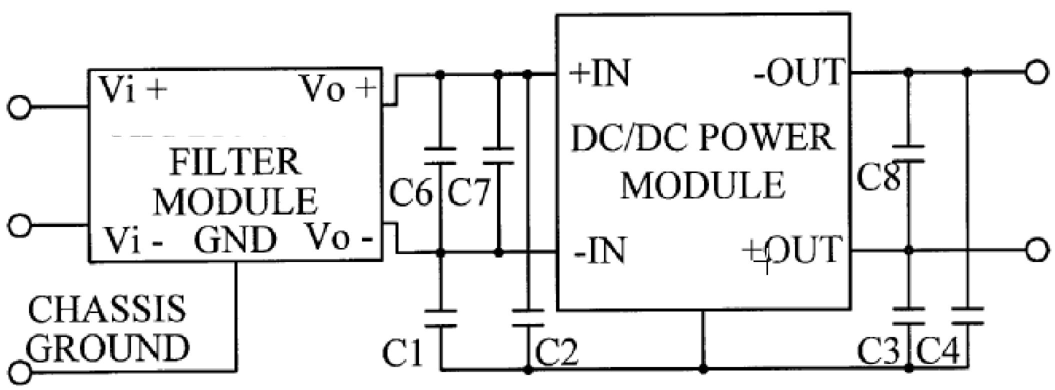
x.xx: ± 0.005

x.xxx: ± 0.015

SCHEMATIC



APPLICATION RECOMMENDATIONS



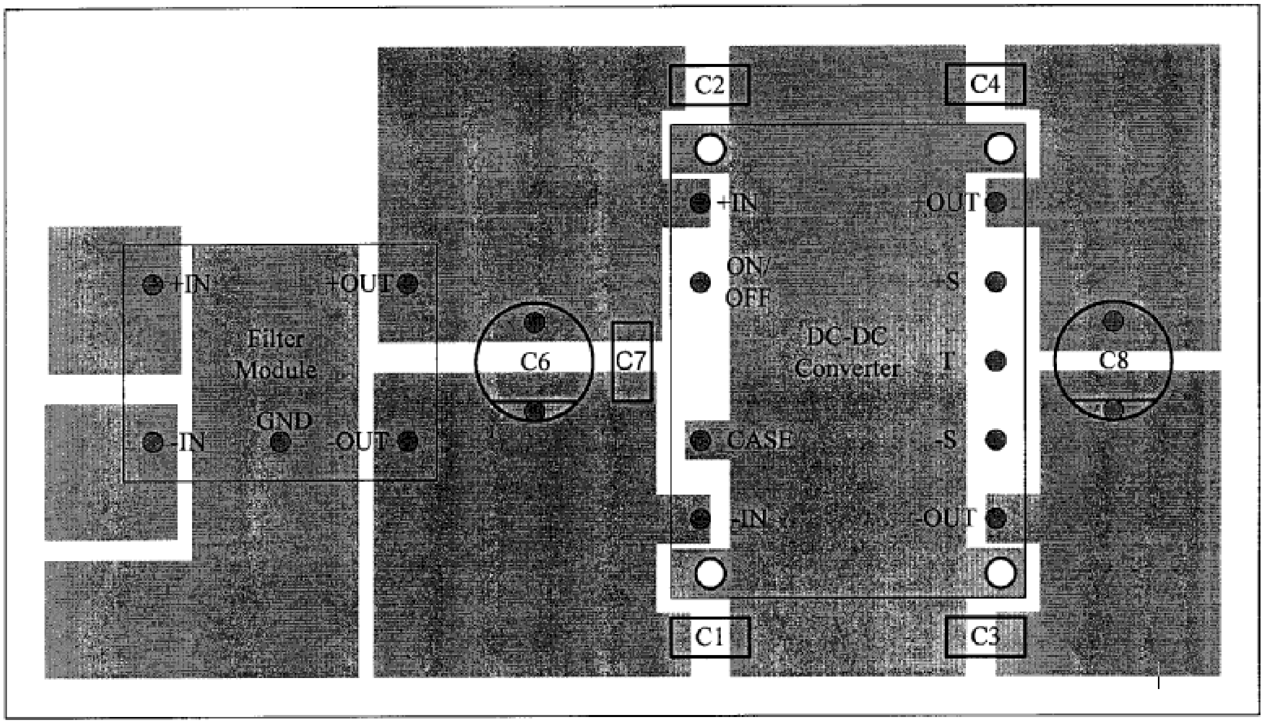
NOTE 1: C1 through C4 can be 0.01uF to 0.1uF.

NOTE 2: C6 ceramic capacitor can be 0uF to 4.7uF.

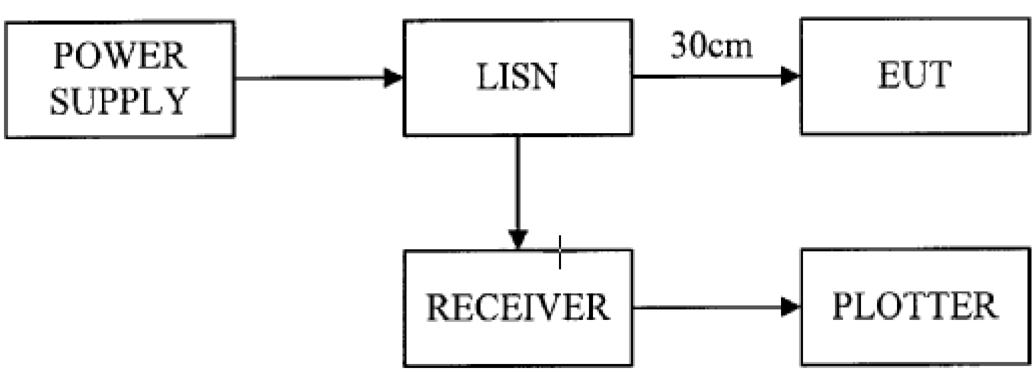
NOTE 3: C7 aluminum electrolytic capacitor.

NOTE 4: C8 aluminum electrolytic capacitor.

RECOMMENDED PCB LAYOUT

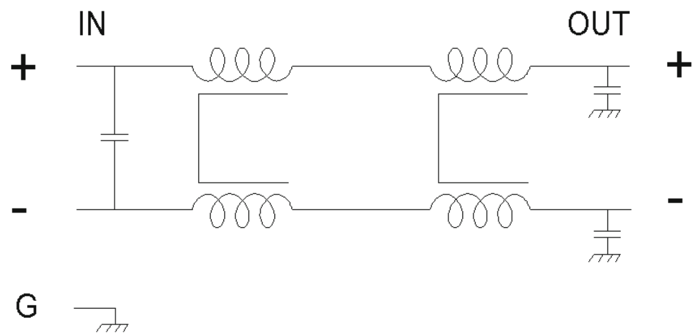


SETUP FOR MEASURING CONDUCTED EMI

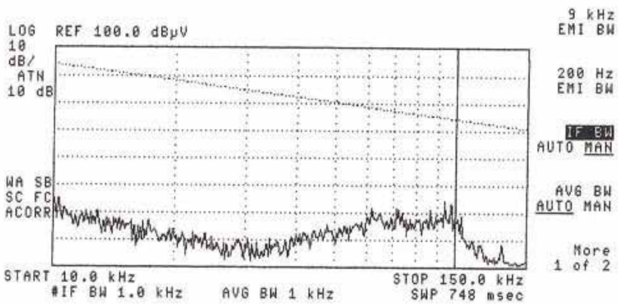


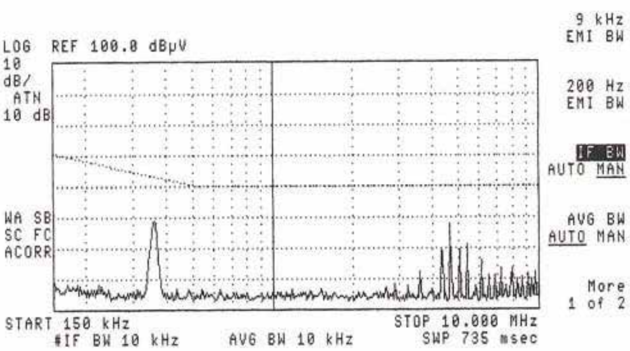
FB50-15

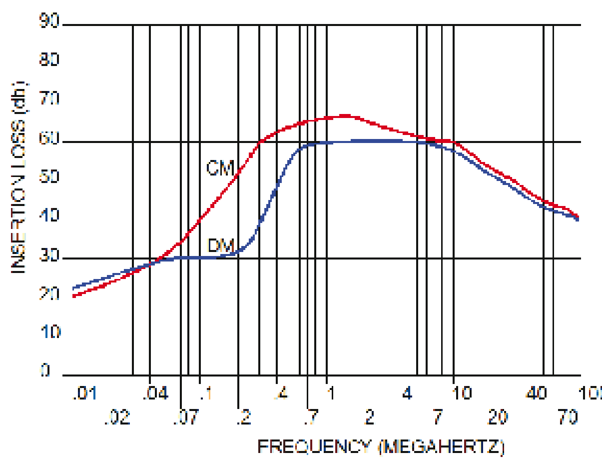
Operating Voltage = 100 Vdc max.
Operating Current Max = 14.0 amp
Temperature Operating = - 40 to 85ºC ambient
Storage Temperature = - 40 to 100ºC
DC Resistance per leg = 0.008 Ω maximum
Calculated MTBF = TBD
Meets CE102 (Conducted Emissions, Power Leads) per the limits as shown in MIL-STD-461E when operating as an input filter for the Astrodyne/RO SV28-150/200 Series DC-DC converters
Circuit to case isolation 100VDC

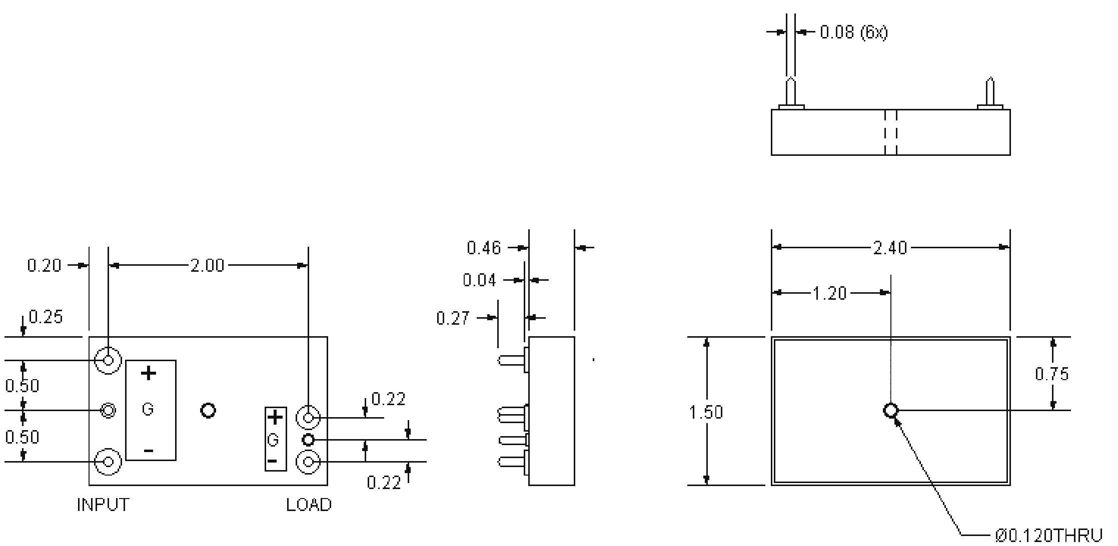


MIL-STD-461F scan with R/O SV28-12-20-1









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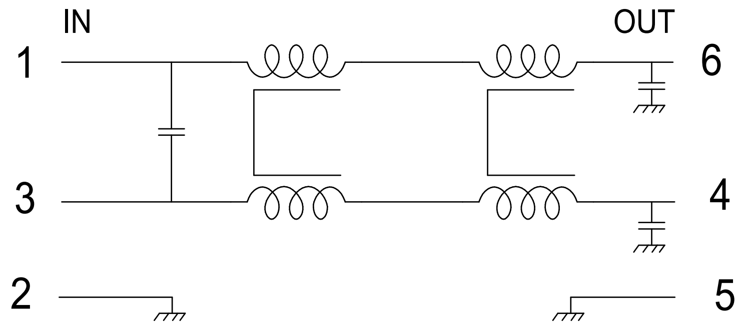
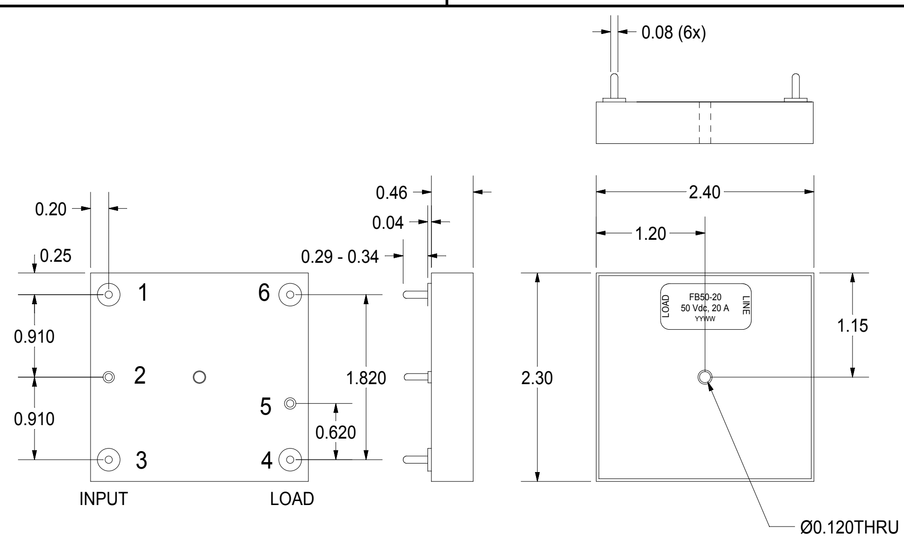
FB50-20

Operating Voltage = 100 Vdc max.
Operating Current Max = 20.0 amp
Temperature Operating = - 40 to 85ºC ambient
Storage Temperature = - 40 to 100ºC
DC Resistance per leg = TBD
Calculated MTBF = TBD
Meets CE102 (Conducted Emissions, Power Leads) per the limits as shown in MIL-STD-461E when operating as an input filter for the Astrodyne/RO UV24 Series DC-DC converters
Circuit to case isolation 100VDC



MIL-STD-461F scan with R/O UV24 Series Data to follow

No Photo Currently Available



Pin numbers are for reference only.
The pins are not marked.
The input ground is off set to facilitate installation.
The filter is not polarized.

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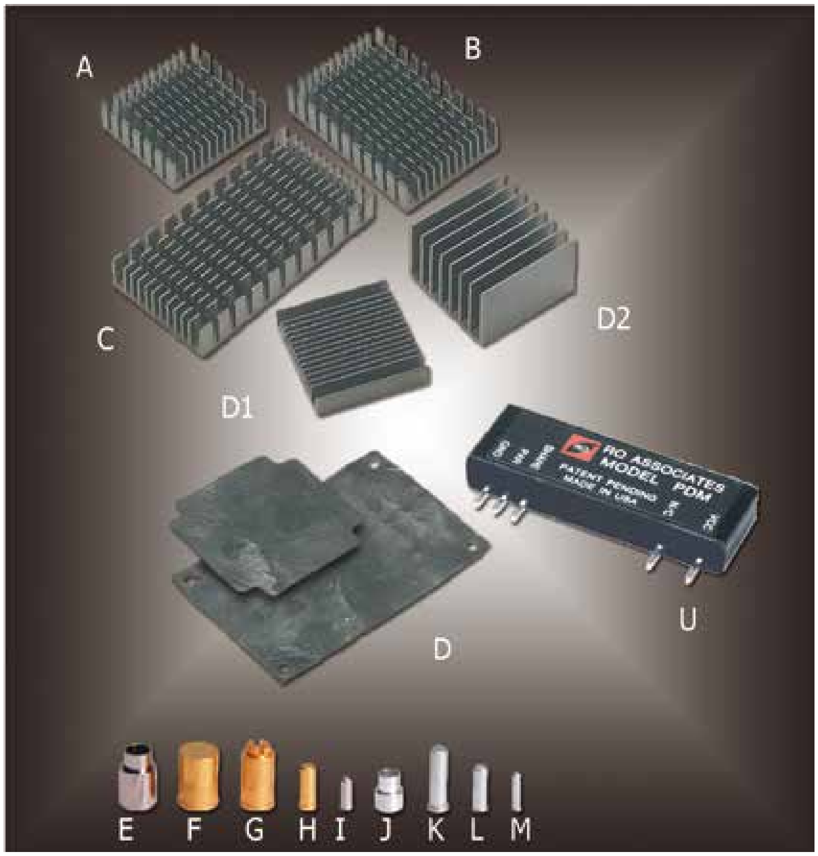
ACCESSORIES

	Part #	Description
HEATSINKS	2003	NanoVerter or PicoVerter
	2005	MicroVerter Single Output
	2006	MicroVerter Triple Output, PFC, MegaVerters
	2021LF	Heatsink for SuperVerter (1.4″ HT, fins Length)
	2024LF	Heatsink for SuperVerter (0.45″ HT, fins Width)
	2025LF	Heatsink for SuperVerter (0.45″ HT, fins Length)
THERMAL PADS	9603	SuperVerter Single
	9604	MicroVerter Single Output
	9605	MicroVerter Triple Output, PFC, MegaVerters
	9608	NanoVerter or PicoVerter
SOCKETS AND STANDOFFS	9741	Socket for .025 Square Pins
	9890	Socket for .040 Dia, Pins, Small
	9871	Socket for .040 Dia, Pins
	9740	Socket for .060 Dia, Pins
	9748	Socket for .080 Dia, Pins
	9894	Socket for .100 Dia, Pins
	9872	Socket for .138 Dia, Pins
	9878	Standoff for MicroVerter or UniVerter
	9528	Standoff for PicoVerter or NanoVerter
FILTERS	HH-2033-15	SV Line Filter 15A, 50V, MIL STD 461
	HH-1199-6	EMI Filter (250V, 6A)
	FB-100-10	SV Line Filter
PARALLELING DE-COUPLING MODULE	PDM	Paralleling De-Coupling Module



PARALLELING DE-COUPLING MODULE (PDM)

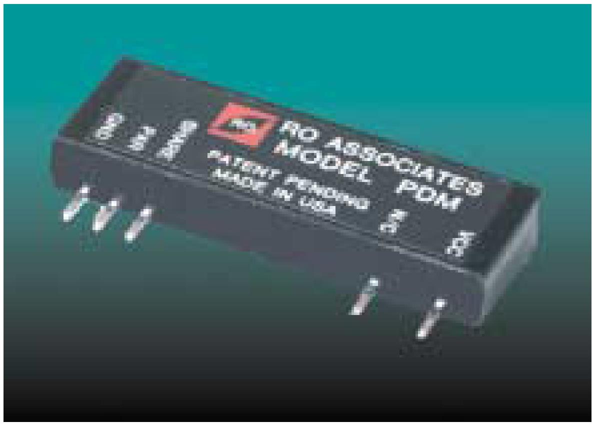
MODEL PDM   U.S. PATENT NO 5,428,523

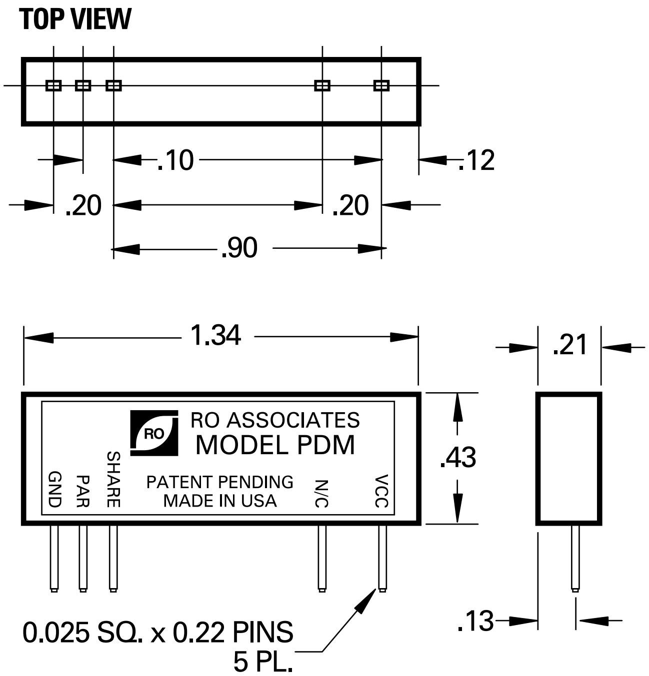
DESCRIPTION

The Paralleling De-Coupling Module isolates the parallel pins when multiple modules are connected in a paralleling, current sharing configuration where redundancy is required. See paralleling connection diagram on page 55.

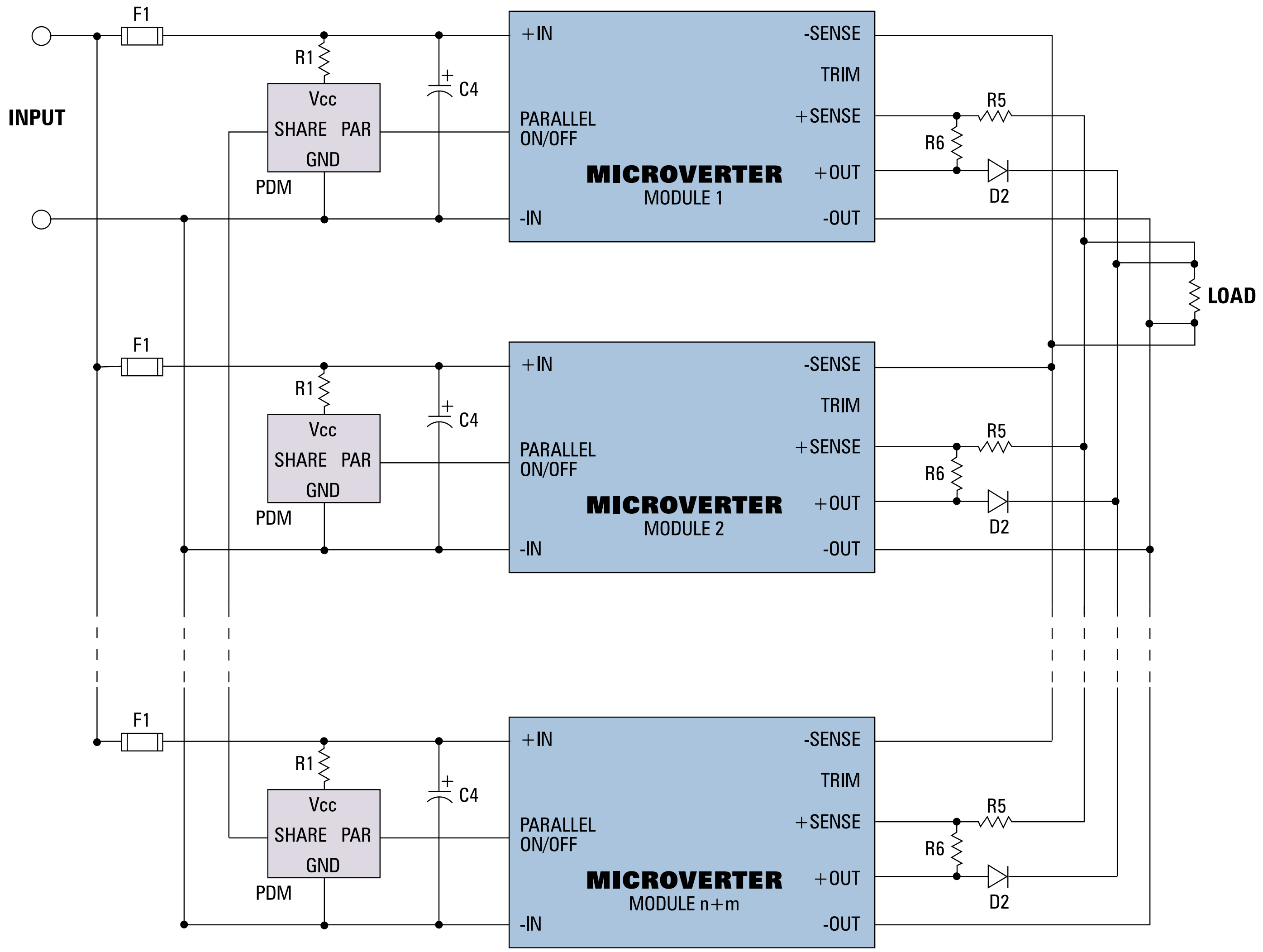
FEATURES

- Isolates Parallel Pin for n+m Redundancy
- Provides Fault Tolerance with No Single Point Of Failure
- De-Couples Faulty Module with Minimum Bus Disturbance
- Re-Couples Replacement Module with Minimum Bus Disturbance During Hot Plug-In
- Allows for Individual Module On/Off
- Low Impedance for Precise Current Sharing
- Convenient SIP Package





PARALLELING CONNECTION



INPUT VOLTAGE

Component	28V	48V	300V
C4	22µf,50V	15µf,100V	0.1µf,600V
R1	5.6K,1/4W	24K,1/4W	160K,2W
F1	15A	8A	2A

OUTPUT VOLTAGE

Component	5V	12V, 15V	24V, 28V
D2	85CNQ015	80CNQ035	63CNQ100
R5	3.3	10	27
R6	47,1W	100,5W	120,12W

APPLICATION NOTES

INDEX OF SELECTED APPLICATION NOTES

A complete set of Application Notes is available from the factory including the following titles:

AP1	Module Handling Considerations
AP2	Mechanical Mounting Considerations
AP3	Input Ripple Measurement and Filtering
AP4	Logic On-Off
AP5	Output Voltage Trimming
AP6	Remote Sensing
AP7	Measuring Line and Load Regulation
AP8	Measuring Output Noise and Ripple
AP9	Trimming Paralleled Modules
AP10	Thermal Considerations
AP11	Non-Redundant Paralleling of UV300 Modules
AP12	Synchronization of Modules
AP13	Paralleling with Current Sharing and n+m Redundancy
AP14	Special Considerations for MicroVerter Triples
AP18	Board Layout Considerations and Recommendations
AP19	Hole Dimensions and Socket Information
AP20	MTBF Calculations
AP23	PFC Load Restrictions During Startup
AP24	Power Factor Correction (PFC) Modules
AP25	SuperVerter DC-DC Converters

AP1 MODULE HANDLING CONSIDERATIONS

GENERAL DESCRIPTION

RO DC-DC and AC-DC converter modules have proven to be extremely rugged and are designed to meet MIL-STD-810D requirements. Also, once they are installed properly on a printed circuit board, they can take all the normal mechanical forces for circuit boards and circuit board mounted components. Reasonable care must exercised, however, during all handling of converter modules, to prevent mechanical damage to the case or the electrical terminal pins.

IMPLEMENTATION

STORAGE

Modules should be kept in their original shipping containers to provide adequate protection until inserted into printed circuit boards.

INSTALLATION INTO PRINTED CIRCUIT BOARD

Reasonable care must be exercised when inserting the pins of a module into the holes or sockets of a printed circuit board during production or prototype fabrication. The pins must all be properly aligned with the holes or sockets before pressure is evenly exerted to the surface of the module to seat it onto the board. Otherwise, overstressed or bent pins could result in external pin breakage, internal damage, or degradation of the module.

REMOVAL FROM PRINTED CIRCUIT BOARD

In soldered applications, solder must be carefully removed from the pin/pad connections and each pin must be observed to be mechanically free from its pad. Once the solder is adequately removed, or for socket applications, the module must be removed using both hands, one on either end of the module, to carefully lift the module evenly off the board. While the pins are clearing the sockets or circuit board holes, the plane of the module baseplate must remain in parallel with the plane of the circuit board. Otherwise, the pins may be over stressed or bent resulting in degradation or failure.

SHIPMENT OF MODULES

In the event that individual modules are shipped as a component and not in a circuit board assembly, adequate protection must be provided to the pins to prevent damage. Utilization of the original plastic shipping tube from RO is recommended.

RELATED TOPICS

AP-2	Mechanical Mounting Considerations
AP-18	Board Layout Considerations and Recommendations
AP-19	Hole Dimensions and Socket Information

AP2 MECHANICAL MOUNTING CONSIDERATIONS

CONTINUED

GENERAL DESCRIPTION

RO DC-DC and AC-DC converter modules have proven to be extremely rugged, and are designed to meet MIL-STD-810D requirements. Also, once they are installed properly on a printed circuit board, they can take all the normal mechanical forces for circuit boards and circuit board mounted components. Reasonable care must be exercised, however, during the design and fabrication of modules into power supply assemblies to prevent excess stress that could cause mechanical damage to the case or the electrical terminal pins.

IMPLEMENTATION

DESIGN

Good mechanical engineering practices must be observed in designing modules into power supply assemblies to prevent excess stress or bending forces on the modules and their electrical terminal pins. Circuit board holes and sockets must be properly located and mechanical attachment to heat sinks and circuit boards must be designed to prevent excess shear, compression, or tensile forces on the pins. (See AP-19, *Hole Dimensions and Socket Information.*)

ASSEMBLY

Good manufacturing procedures must be observed in assembling modules into power supply assemblies to prevent excess stress on the modules or pins. Reasonable care must be exercised in inserting (and removing) modules from printed circuit boards (See AP-1, *Module Handling Considerations*).

In particular, care must be exercised in applications where a single heat sink is attached to more than one module in a soldered application. If possible, the heat sink should be assembled to the modules prior to soldering. In situations where this is not possible, care must be exercised to insure that bolting of the modules to the heat sink following the soldering operation does not result in excess stress on the pins. One approach might be to fixture the modules during soldering to insure their baseplates are co-planer and to also insure that the heat sink is flat and that pin forces are reasonable during and after assembly.

RELATED TOPICS

AP-1 Module Handling Considerations

AP-18 Board Layout Considerations and Recommendations

AP-19 Hole Dimensions and Socket Information

AP5 OUTPUT VOLTAGE TRIMMING

GENERAL DESCRIPTION

Output voltage trimming allows the user to change the output voltage of the module. This greatly enhances the functionality of modules by allowing a few select, standard modules to be applied to virtually any application; regardless of the voltage requirements. This allows module users to reduce the number of models kept in stock.

This application note covers the basics of trimming all RO modules available as of June 2002. The format of the trim equation has been modified so that a single trimming equation can be used. The equation parameters for a particular module can be found in the relevant parameters table.

Also covered, are the effects of trimming on various performance parameters, application ideas for trimming, and important precautions to observe.

IMPLEMENTATION

BASIC TRIMMING CONCEPTS

RO uses a simple approach to trimming modules that in most cases allows the module to be trimmed with a single external resistor. There are two types of trimming used in RO modules: Inverting trim, in which the trim signal is summed in with the sense feedback and Non-inverting trim, in which the trim signal is used to modify the reference for the control circuits. In either case, to trim the module's output connect a resistor from TRIM to either +SENSE or -SENSE depending on whether you want a lower or higher than nominal output voltage and which type of trimming the module uses. Each of the following parameter tables indicates which type of trimming is used by the module, whether to connect to +SENSE or –SENSE, and the parameter values to enter in the trim equation. The figures accompanying the tables show the appropriate connections.

To calculate the resistor value use the following equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} \, x k\Omega$$

Where:

A and B = The equation parameters given in the tables.

$|\Delta V|$ = The magnitude of the desired voltage change from the nominal output voltage. $|\Delta V|$ is always positive.

QUATTROVERTER TRIMMING

The trimming parameters for the QUATTROVERTER modules are given in Table 5a. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} \, x k\Omega$$

The QUATTROVERTER modules use a non-inverting trim function. To trim the output voltage UP, connect the trim resistor from TRIM to +SENSE. To trim the output voltage DOWN, connect the trim resistor from TRIM to -SENSE. These connections are shown in Figure 5a.

AP5 OUTPUT VOLTAGE TRIMMING
CONTINUED

Model Suffix	V nom (V)	Trim up A	Trim up B	Trim down A	Trim down B	Min. Vout	Max. Vout
-1.8	1.8	4.154	-2.802	9.198	-10.22	1.44	1.98
-2.5	2.5	12.98	.08242	12.78	-10.22	2.00	2.75
-3.3	3.3	28.01	3.379	16.86	-10.22	2.64	3.63
-5	5.0	77.47	10.38	25.55	-10.22	4	5.5

Table 5a QUATTROVERTER Trimming Parameters.
(Connections shown in Figure 5a).

Example: An application requires 26.5A at 1.90V to drive a DSP based voice messaging system. In this application we will use the "–30" version of the 1.8V QuattroVerter module, which has a current rating of 30A and is perfect for this application. The required trim resistor is:

$$R_{trim} = \frac{4.154 - 2.802x|0.1|}{|0.1|} xk\Omega$$

$$R_{trim} = 38.74xk\Omega$$

For our application we will use a 38.3 k Ω, 1%, temperature stable, SMT chip resistor connected from TRIM to +SENSE.

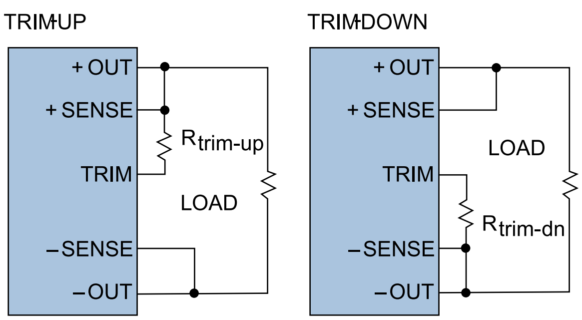


Figure 5a Basic circuits for QUATTROVERTER trim-up and trim-down applications.

TRIMMING

The trimming parameters are given in Table 5b. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + Bx|\Delta V|}{|\Delta V|} xk\Omega$$

The modules use a non-inverting trim function. To trim the voltage UP, connect the trim resistor from TRIM to +SENSE. To trim the output voltage DOWN, connect the trim resistor from TRIM to -SENSE. These connections are shown in Figure 5b.

Model Suffix	V_{nom} (V)	Trim Up A	Trim Up B	Trim Down A	Trim Down B	Min. Vout	Max. Vout
-1.8	1.8	.8129	-.5484	1.8	-2	1.44	1.98
-2.5	2.5	2.540	.01613	2.5	-2	2.00	2.75
-3.3	3.3	5.482	.6613	3.3	-2	2.64	3.63
-5	5.0	15.16	2.032	5.0	-2	4	5.5

Table 5b Trimming Parameters.
(Connections shown in Figure 5b).

Example: An application requires 39A at 2.1V to power a processor in an internet router. In this application we will use the "–45" version of the 2.5V SyncroVerter module. This 2.5V module has a current rating of 45A, which is sufficient for this application. The required trim resistor is:

$$R_{trim} = \frac{2.500 - 2x|0.4|}{|0.4|} xk\Omega$$

$$R_{trim} = 4.25xk\Omega$$

For our application we will use a 4.22 k Ω, 1%, temperature stable, SMT chip resistor connected from TRIM to -SENSE.

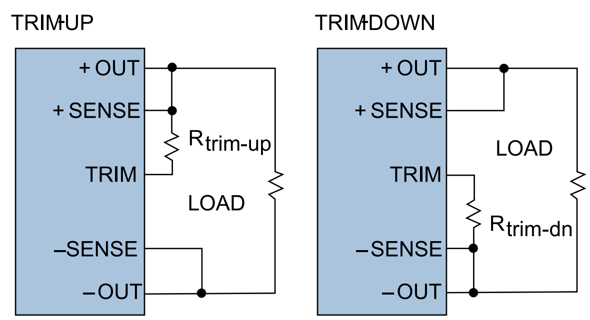


Figure 5b Basic circuits for trim-up and trim-down applications.

SUPERVERTER DUAL TRIMMING

The trimming parameters for the SUPERVERTER DUAL modules are given in Table 5c. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} xk\Omega$$

The SUPERVERTER DUAL modules use an inverting trim function. To trim the output voltage UP , connect the trim resistor from TRIM to -SENSE. To trim the output voltage DOWN , connect the trim resistor from TRIM to +SENSE. These connections are shown in Figure 5c.

Output #	Vnom (V)	Trim up A	Trim up B	Trim down A	Trim down B	Min. Vout	Max. Vout
2	1.8	1.250	-5.110	.5645	-6.118	1.62	1.98
2	2.5	6.250	-10.00	6.350	-15.04	2.25	2.75
1	3.3	2.069	-5.110	3.437	-6.779	2.97	3.63
2	3.3	.8000	-.3650	.2560	-.6850	2.97	3.63
1	5	2.508	-3.320	2.508	-4.323	4.5	5.5

Table 5cSUPERVERTER DUAL Trimming Parameters. (Connections shown in Figure 5c).

Example: An application requires 12A at 2.3V to drive a processor core and 3.3V at 8A to drive the peripheral I/O. In this application we will use the 3.3V/ 2.5V SUPERVERTER DUAL module. Both outputs are within their respective current rating and are acceptable for this application. We need to trim the 2.5V output down to 2.3V. The 2.5V output is output #2 on the SVD48-3325 module so the required trim resistor is:

$$R_{trim} = \frac{6.350 \; -15.04x \; |\; 0.2 \;|}{|\; 0.2 \;|} xk\;\Omega$$

$$R_{trim} = 16.71xk \; \Omega$$

For our application we will use a 16.9k Ω, 1%, temperature stable, SMT chip resistor connected from TRIM to -SENSE.

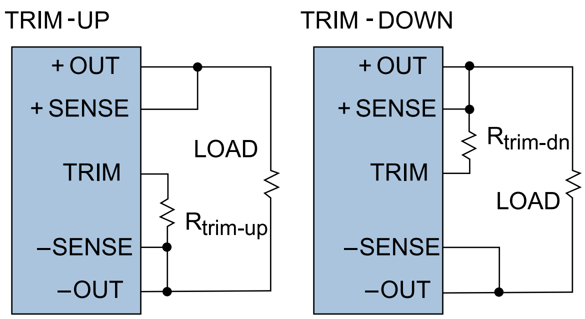


Figure 5cBasic circuits for SUPERVERTER DUAL trim-up and trim-down applications.

SUPERVERTER TRIMMING

The trimming parameters for the SUPERVERTER modules are given in Table 5d. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} xk\Omega$$

The SUPERVERTER modules use a non-inverting trim function. To trim the output voltage UP , connect the trim resistor from TRIM to +SENSE. To trim the output voltage DOWN , connect the trim resistor from TRIM to -SENSE. These connections are shown in Figure 5d.

Model Suffix	V_{nom} (V)	Trim up A	Trim up B	Trim down A	Trim down B	Min. Vout	Max. Vout
-2.5	2.5	2.540	0.01613	2.5	-2	1.5	2.75
-3.3	3.3	5.482	0.6613	3.3	-2	1.98	3.63
-5	5	15.16	2.032	5	-2	3.00	5.5
-12	12	104.1	7.677	12	-2	7.20	13.2
-15	15	166.5	10.10	15	-	9.00	16.5
-24	24	440.5	17.35	24	-2	14.4	26.4
-28	28	604.3	20.58	28	-2	16.8	30.8

Table 5dSUPERVERTER Trimming Parameters. (Connections shown in Figure 5d).

AP5 OUTPUT VOLTAGE TRIMMING

CONTINUED

Example: An application requires 11.5A at 10V to drive a cooling system for a super conducting RF receiver-filter in a cellular base station. In this application we will use the –150 version of a 12V SuperVerter module. The 12V module has a current rating of 12.5A, which is good for this application. The required trim resistor is:

$$R_{trim} = \frac{12.000-2x|2|}{|2|} xk\Omega$$

$$R_{trim} = 4.00xk\Omega$$

For our application we will use a 4.02 Ω, 1%, temperature stable, SMT chip resistor connected from TRIM to -SENSE.

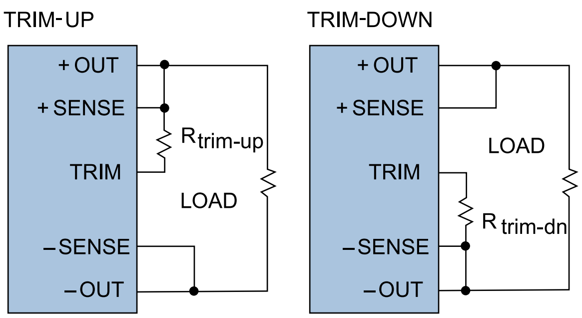


Figure 5d Basic circuits for SUPERVERTER trim-up and trim-down applications.

PICOVERTER TRIMMING

The trimming parameters for the PICOVERTER modules are given in Table 5e. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A+Bx|\Delta V|}{|\Delta V|} xk\Omega$$

The PICOVERTER modules use an inverting trim function. To trim the output voltage <u>UP</u>, connect the trim resistor from TRIM to –SENSE. To trim the output voltage <u>DOWN</u>, connect the trim resistor from TRIM to +SENSE. These connections are shown in Figure 5e.

Model Suffix	V_{nom} (V)	Trim up A	B	Trim down A	B	Min. Vout	Max. Vout
-3	3.3	1.986	0	3.300	-1.602	2.97	3.63
-5	5	12.58	0	12.58	-5.030	4.5	5.5
-12	12	41.80	0	158.8	-16.72	10.8	13.2
-15	15	51.92	0	259.6	-20.77	13.5	16.5
-24	24	104.4	0	897.9	-41.76	21.6	26.4

Table 5e PICOVERTER Trimming Parameters (Connections shown in Figure 5e).

Example: A designer has a system that uses both 12V and 15V PICOVERTER modules. She would like to minimize part count and lower cost by only using one model of the PICOVERTER series. By checking with the factory she learned that the 15V PICOVERTER module can be trimmed down to 12V and still handle the modest load requirements. The required trim down resistor is:

$$R_{trim} = \frac{259.6-20.77x|3|}{|3|} xk\Omega$$

$$R_{trim} = 65.76xk\Omega$$

She used a 66.5kΩ, 1%, temperature stable, metal film resistor for the trim down resistor and connect it from TRIM to +SENSE.

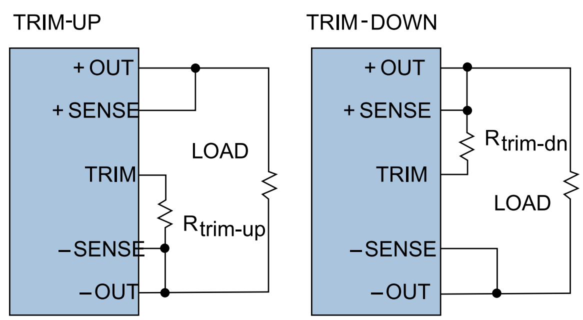


Figure 5e Basic circuits for PICOVERTER trim-up and trim-down applications.

MICROVERTER TRIMMING

The trimming parameters for the MICROVERTER modules are given in Table 5f. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} x k\Omega$$

The MICROVERTER modules use an inverting trim function. To trim the output voltage UP , connect the trim resistor from TRIM to –SENSE. To trim the output voltage DOWN , connect the trim resistor from TRIM to +SENSE. These connections are shown in Figure 5f.

Model Suffix	V_{nom} (V)	Trim up A	B	Trim down A	B	Min. Vout	Max. Vout
-2	2.1	6.394	0	2.558	-4.263	1.89	2.31
-3	3.3	18.90	0	22.68	-12.60	2.97	3.63
-5	5	8.516	0	19.87	-5.677	4.5	5.5
-8	8	15.84	0	68.66	-10.56	5.5	8.8
-12	12	29.01	0	203.0	-19.34	10.8	13.2
-15	15	29.84	0	268.5	-19.89	13.5	16.5
-24	24	62.16	0	932.3	-41.44	21.6	26.4
-28	28	62.75	0	1109	-41.83	25.2	30.8
-T512	5	1.576	0	3.677	-1.051	4.5	5.5
-T515	5	1.576	0	3.677	-1.051	4.5	5.5

Table 5f: MICROVERTER Trimming Parameters. (Connections shown in Figure 5f).

Example: An application requires 9A at 26V to drive a RF amplifier in a cellular transmitter. In this application we could use either a 28V module trimmed down to 26V or a 24V module trimmed up to 26V. The 28V module would have a current rating of 9A. The 24V module has a power rating of 24V x 10A or 240W. At 26V the output current must be limited to 240W/26V=9.23A, which is acceptable for the application. For our example we will choose the 24V module since it will be more efficient (module efficiency improves when the output is trimmed up and degrades when the output is trimmed down) and we don't need the lower current limit. The required trim resistor is:

$$R_{trim} = \frac{62.16 + 0 x |2|}{|2|} x k\Omega$$

$$R_{trim} = 31.08 x k\Omega$$

For our application we will use a 30.9k Ω, 1%, temperature stable, film resistor connected from TRIM to -SENSE.

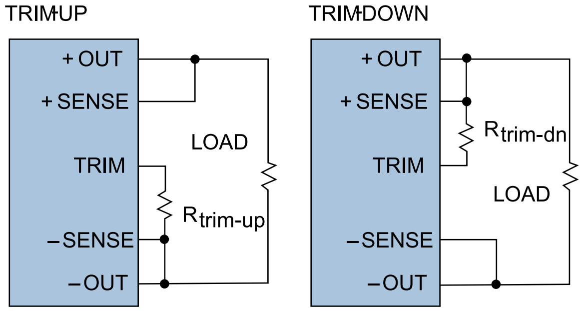


Figure 5f: Basic circuits for MICROVERTER trim-up and trim-down applications.

MEGAVERTER TRIMMING

The trimming parameters for the MEGAVERTER modules are given in Table 5g. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B x |\Delta V|}{|\Delta V|} x k\Omega$$

The MEGAVERTER modules use an inverting trim function. To trim the output voltage UP, connect the trim resistor from TRIM to –SENSE. To trim the output voltage DOWN , connect the trim resistor from TRIM to +SENSE. These connections are shown in Figure 5g.

AP5 OUTPUT VOLTAGE TRIMMING

CONTINUED

Model Suffix	V_{nom} (V)	Trim up A	Trim up B	Trim down A	Trim down B	Min. Vout	Max. Vout
MV48-5	5	3.549	0	10.76	-2.862	4.5	5.5
MV48-26	26	32.76	-2.67	308.0	-15.78	18**	30
MV380-26	26	32.76	-2.67	308.0	-15.78	18**	30
MV380-48	48	40.56	-2.67	738.2	-18.89	40	51
MV380-56	56	47.81	-2.67	1023	-21.79	48	60

**Minimum load conditions apply below 20V out. See the data sheet.

Table 5g: MEGAVERTER Trimming Parameters. (Connections shown in Figure 5g).

Example: An application requires 18A at 24V to drive a microwave amplifier in a communications data link. In this application we will use a 26V MegaVerter module trimmed down to 24V. The required trim resistor is:

$$R_{trim} = \frac{1023 - 21.79 \times |2|}{|2|} \times k\Omega$$

$$R_{trim} = 490 \times k\Omega$$

For our application we will use a 487kΩ, 1%, temperature stable, film resistor connected from TRIM to +SENSE.

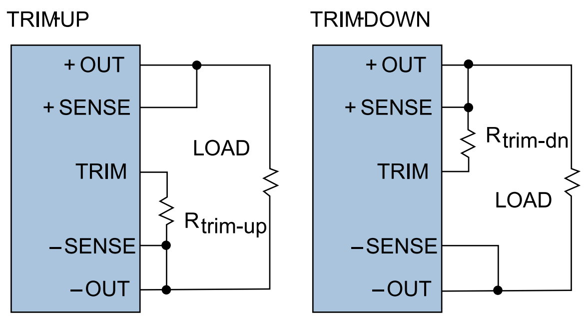


Figure 5g: Basic circuits for MEGAVERTER trim-up and trim-down applications.

NANOVERTER TRIMMING

The trimming parameters for the NANOVERTER modules are given in Table 5h. These parameters, along with the desired change in output voltage are plugged into the trim resistor equation:

$$R_{trim} = \frac{A + B \times |\Delta V|}{|\Delta V|} \times k\Omega$$

The NANOVERTER modules use an inverting trim function. To trim the output voltage UP, connect the trim resistor from TRIM to –SENSE. To trim the output voltage DOWN, connect the trim resistor from TRIM to +SENSE. These connections are shown in Figure 5h.

Model Suffix	V_{nom} (V)	Trim up A	Trim up B	Trim down A	Trim down B	Min. Vout	Max. Vout
-2	2.1	0.2778	-.3320	.01389	-.4709	2.00	2.21
-3	3.3	0.7424	-.3320	.2376	-.6290	2.97	3.47
-5	5	1.438	-.3320	1.438	-.9070	4.5	5.5
-12	12	3.186	-.3320	12.11	-1.607	10.8	13.2
-15	15	3.354	-.3320	16.77	-1.674	13.5	16.5
-24	24	6.876	-.3320	59.13	-3.082	21.6	26.4

Table 5h: NANOVERTER Trimming Parameters. (Connections shown in Figure 5h).

Example: A 5V logic system needs the capability to perform margin testing. The margin limits are 4.5V and 5.5V. The required trim DOWN resistor is:

$$R_{trim} = \frac{1.438 - 0.9070 \times |0.5|}{|0.5|} \times k\Omega$$

$$R_{trim} = 1.969 \times k\Omega$$

The required trim UP resistor is:

$$R_{trim} = \frac{1.438 - 0.3320 x |0.5|}{|0.5|} x k\Omega$$

$$R_{trim} = 2.544 x k\Omega$$

For this example we will use a 1.96k Ω, 1%, temperature stable, SMT chip for the trim down resistor and a 2.55k Ω, 1% temperature stable, SMT chip for the trim up resistor. See Figure 5i for the example schematic.

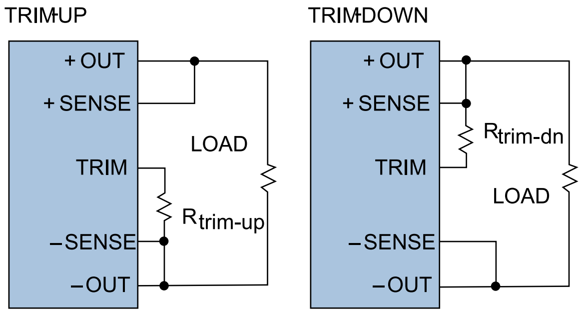


Figure 5h: Basic circuits for NANOVERTER trim-up and trim-down applications.

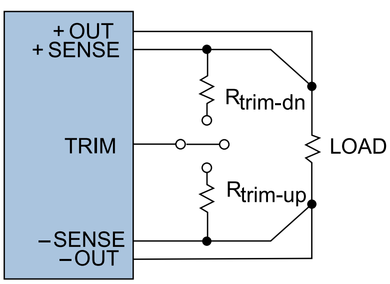


Figure 5i: Circuit for NANOVERTER trimming example: Voltage margining using a switch.

PERFORMANCE EFFECTS OF OUTPUT TRIMMING

Several of the module performance parameters will change as the output voltage is trimmed. All specifications given in the data sheets apply over the guaranteed adjustment range. The specifications of primary concern are: efficiency, output ripple, and output OVP.

Efficiency – The efficiency of a given model will decrease as the output voltage is trimmed down and increase as the voltage is trimmed up.

Output Ripple – As a percentage of the output voltage, the output ripple will increase as the voltage is lowered and decrease as the voltage is raised.

Output OVP – The OVP set point remains at a fixed voltage, independent of output trimming. In most cases the OVP set point is what limits the maximum trimmable voltage.

As an additional note the user must pay attention to the current and power ratings when trimming the output voltage. All RO converters have a fixed current limit. As the output voltage is trimmed down the current limit set point remains constant. Therefore, in terms of output power, if the unit is trimmed down the available output power drops proportionally. Likewise, if the output is trimmed up the available power appears to go up, however, do not exceed the maximum rated output power of the module when trimming the output up.

AP5 OUTPUT VOLTAGE TRIMMING

CONTINUED

POSSIBLE APPLICATIONS

Eliminating the need for remote sense – Output trimming can be used instead of remote sense when the load current change is limited and the voltage drop between converter and load is relatively constant.

System testing (margining) – Often, it's helpful to test system operation with the supply voltage – usually the +5V logic voltage – set first at one extreme, then at the other. Any circuitry that fails to perform properly under these manufacturer's test conditions might also fail under conditions found in the user's environment. Margin testing helps insure trouble-free system operation.

Obtaining non-standard output voltages – When a non-standard output voltage is necessary, it may be available simply by trimming the output voltage of a module with an output voltage that's close to the desired voltage. Although the published data sheet limits are valid for the guaranteed adjustment range, lower output voltages are commonly available by using the trim function. Contact the factory for details.

Reducing the number of stocked models – When two output voltages are necessary, such as 24V and 28V, one model may be able to supply both, using the trim function to set the lower voltage.

PRECAUTIONS

Connect trim resistor to sense, not to output – The trim resistor(s) should be connected to the sense leads, not to the output leads or to the load. Otherwise, load current changes could cause the converter's trimmed output voltage to vary.

Noise sensitivity – The TRIM pin is noise sensitive. External resistors (either fixed or variable) should be located within one cm of the converter. If wires are necessary, use twisted or shielded wires.

Output power, output current – If the output voltage is increased, output current must be derated to avoid exceeding module maximum output power. If the output voltage is decreased, output current is limited to its maximum rating and the available output power decreases.

Adjustment range limits – In some cases, the output voltage can be trimmed outside the guaranteed adjustment range. However, data sheet specifications are only valid within the specified voltage range.

RELATED TOPICS

AP-6 Remote Sensing

AP-9 Trimming Paralleled Modules

AP-18 Board Layout Considerations and Recommendations

AP6 REMOTE SENSING

GENERAL DESCRIPTION

The remote sense feature provides excellent regulation at the load rather than at the converter's output terminals. It does this by sensing and regulating voltage at the load, compensating for load current IR drops across output connectors, traces, and cables as well as "or'ing" diode forward voltage drops.

The remote sense feature will compensate for voltage drops up to 0.5V or 10% of nominal output voltage, whichever is greater. If the total voltage drop between output terminals and load exceeds this amount, other design changes, such as increasing conductor size or decreasing connector resistance, must be taken.

RO has also recommended diodes for or'ing applications that minimize forward voltage drop. Please see AP13 for details.

Voltage drops across output series resistance ("IRdrops") vary with output current. If the load current stays relatively constant, RO recommends using output voltage trim instead of remote sensing. (See AP5)

(Output voltage trim increases the output voltage by a fixed amount to compensate for IR drops between the module and the load; remote sense increases the output voltage dynamically to compensate for variable IR drops due to load current changes.)

Voltage drops across or'ing diodes (diodes that isolate one converter's output from another paralleled converter's) tend to stay relatively constant with load current variations, but change with diode temperature. RO recommends using remote sense when using or'ing diodes if precise regulation is needed.

IMPLEMENTATION

The remote sense terminals must always be connected, either to the output terminals or to the load. Connect -SENSE to -OUT at the load and +SENSE to +OUT at the load as shown in Figure 6a.

To reduce noise susceptibility, parallel an electrolytic capacitor and small ceramic capacitor across the remote sense terminals where they are connected to the load as shown in Figure 6a. (Tantalum may be used in lieu of electrolytic capacitors) Please refer to Table 6-1 for recommended values.

Noise filter capacitors are especially helpful when the remote sense leads are over one foot long.

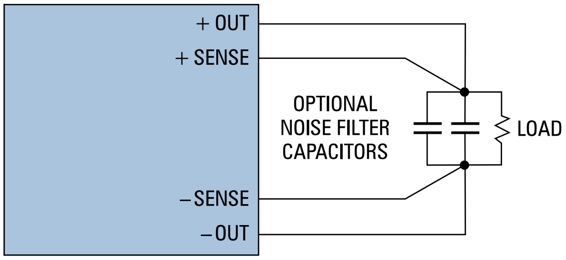


Figure 6a: *Remote sense implementation showing the remote sense leads and filter capacitors connected at the point of load.*

When using traces for the remote sense connection, shield the traces by using a ground plane. (See AP18)

When using wires (rather than traces) for remote sense connections, twist the wires together to reduce noise pickup, or better, use coax.

AP6 REMOTE SENSING

CONTINUED

SUGGESTED FILTER CAPACITOR VALUES			
V_{out}	Electrolytic Capacitor	Tantalum in lieu of electrolytic	Ceramic Capacitor
2.1V, 3.3V	4700µF, 6V	330µF, 6V	0.47µF, Z5U
5.0V	2200µF, 10V	220µF, 10V	0.47µF, Z5U
8.0V	1500µF, 16V	150µF, 15V	0.47µF, Z5U
12V, 15V	1000µF, 35V	68µF, 25V	0.47µF, Z5U
24V, 28V	470µF, 50V	22µF, 50V	0.47µF, Z5U

Table 6-1: Recommended capacitor values for reducing remote sense noise susceptibility.

Although available on all models, remote sense is most useful for high current (low voltage) models,where the potential IR drops are higher.

PRECAUTIONS

Improper use of the remote sense feature can introduce noise into the module's feedback loop, resulting in output noise or oscillations. There are several ways to minimize remote sense lead noise pickup.

(a) Use shielded and/or twisted leads for remote sensing. Also consider using coax cable.

(b) Use noise filter capacitors connected across the remote sense leads at the load. See Figure 6a and Table 6-1 for further information.

(c) Use output voltage trim to make up for IR drops instead of remote sense if the load current does not change appreciably. (See AP5)

If the sense leads fail open circuit, the module output voltage will rise to the OVP set point. If there is any possibility of this situation, connect a 100W resistor from +OUT to +SENSE, and from -OUT to -SENSE.

Be careful not to reverse the sense leads. If reversed, the module will be damaged. Astrodyne recommends using keyed connectors.

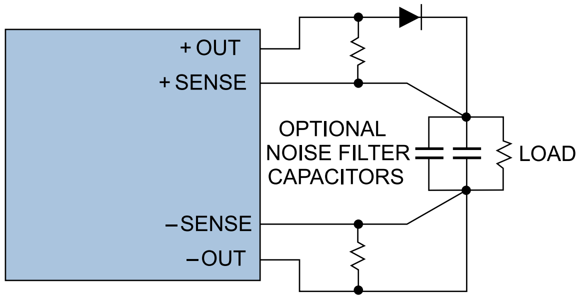


Figure 6b: When there is a possibility of remote sense leads failing open, connect a 20 Ω resistor from each SENSE terminal to its respective OUT terminal at the converter. Also shown is an optional or'ing diode used when paralleling two or more converters.

RELATED TOPICS

AP-5 Output Voltage Trimming

AP-7 Measuring Line and Load Regulation

AP-13 Paralleling with Current Sharing and n+m Redundancy

AP-18 Board Layout Considerations and Recommendations

AP7 MEASURING LINE AND LOAD REGULATION

GENERAL DESCRIPTION

Line regulation is the module's ability to maintain a constant output voltage as the line (input) voltage changes. Load regulation is the module's ability to maintain a constant output voltage as the load current changes.

Line and load regulation are two of the most common types of converter measurements. Although straightforward, there are some simple guidelines that will help insure accurate readings.

To check the module for regulation, measure the output voltage at the sense pins (+SENSE and -SENSE). There is virtually no current flowing through the sense leads, and consequently no appreciable drop across them. Therefore, measuring at the sense pins is equivalent to measuring at the point where the sense leads are connected to the output leads.

In contrast, there can be a significant voltage drop between the module's output terminals and the load. This voltage drop, which varies with load current, can cause erroneous regulation values. The remote sense terminals should always be connected to the output either at the output terminals or at the load. (Connect -SENSE to -OUT and +SENSE to +OUT.)

Line Regulation: Connect a DVM to the sense terminals. Vary the input voltage from minimum to maximum. The output voltage change, as a percentage of nominal output voltage, is the line regulation. See Figure 7a.

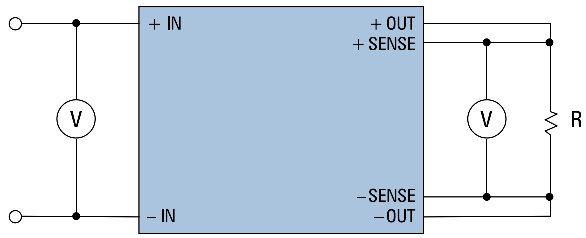


Figure 7a: *Detail of line (input) regulation measurement circuit*

Load Regulation: Connect a DVM to the sense terminals. Vary the load current from zero to maximum. The output voltage change, as a percentage of nominal output voltage, is the load regulation. See Figure 7b.

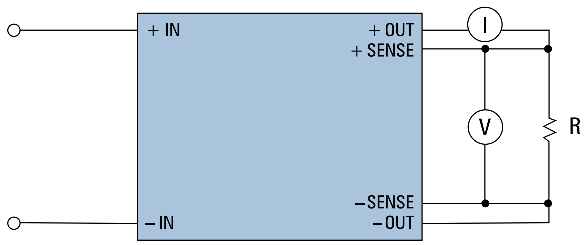


Figure 7b: *Detail of load regulation measurement circuit*

AP8 MEASURING OUTPUT NOISE AND RIPPLE

GENERAL DESCRIPTION

Accurately measuring output noise and ripple requires a basic understanding of the high frequency nature of noise. Very often, "noise" (as commonly measured) is actually the vector sum of common and differential-mode noise.

Common mode noise is common to both outputs (that is, to +OUT and -OUT) with respect to chassis or earth ground. Differential mode noise is found at one output with respect to the other.

While the system load can be affected by differential mode noise, it is seldom affected by common mode noise. The latter is often only created in the process of measuring the former.

Noise can be measured as RMS or peak-to-peak. Low frequency noise with a low peak-to-average ratio is often measured as RMS. High frequency spike noise is more meaningfully measured with an oscilloscope as peak-to-peak noise. The following information pertains to measuring high frequency spike noise.

IMPLEMENTATION

The preferred test setup includes a custom probe made from a length of RG58 A/U coaxial cable. It is connected to the oscilloscope with a BNC "T" connector, which is terminated with a 47W carbon composition resistor in series with a 0.68mF Z5U capacitor. The other end of the coax is left bare. See Figure 8a.

Measure noise as closely as possible to the converter's output terminals to reduce noise pickup.

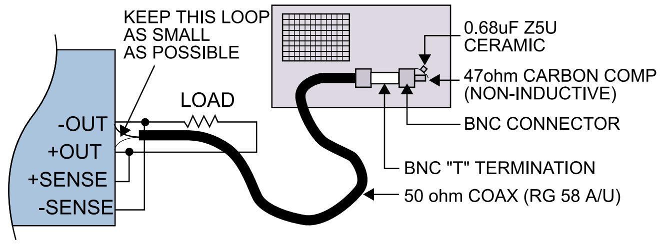


Figure 8a: Output noise test setup. The 47 Ω series with the 0.68μF capacitor decouples the DC while terminating high frequencies with 50 Ω (47Ω). The -3dB frequency is 5kHz

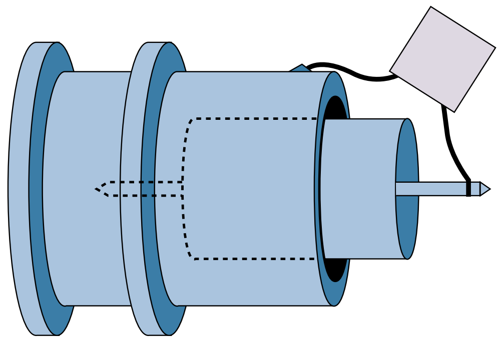


Figure 8b: Detail of BNC termination, showing the 47 Ω carbon composition (non-inductive) resistor in series with the 0.68μF Z5U capacitor.

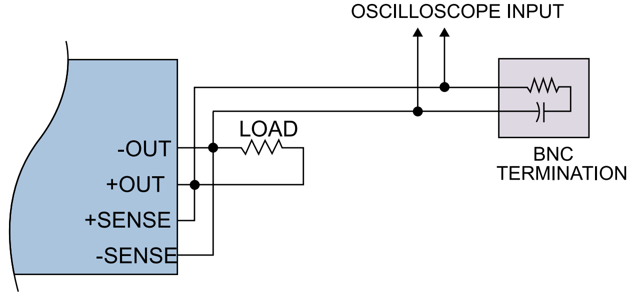


Figure 8c : Schematic diagram of noise test setup.

USING AN OSCILLOSCOPE PROBE

If an oscilloscope probe must be used, it must be properly prepared for high frequency measurements.

The greatest error source is usually the unshielded portion of the oscilloscope probe. Error voltages induced by magnetic radiation in the loop can easily swamp out the actual values. To reduce measurement errors, keep unshielded leads as short as possible.

Prepare the probe for high frequency measurements by first removing the clip-on ground wire and the probe body fishhook adapter. Attach a special tip and ground lead assembly as shown in Figure 8d. These assemblies are available from several manufacturers:

- Hewlett Packard
- Kikusui
- LeCroy

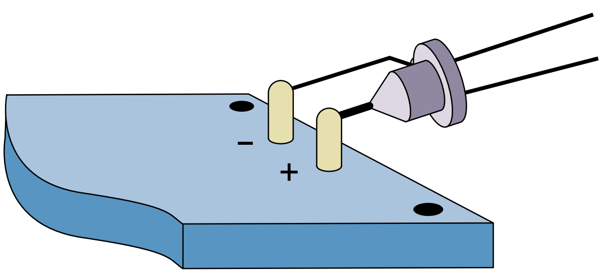


***Figure 8d**: Prepare oscilloscope probe for high frequency measurements by removing the ground clip and fishhook adapter. Slip on a special oscilloscope probe tip and ground lead assembly, and contact the output terminals as shown.*

Determine if there is any common mode noise by simultaneously contacting the probe tip and ground lead to the -OUT pin. Any scope pattern indicates common mode noise, and must be eliminated before accurate measurements can be taken.

To eliminate the noise:

- Wrap the oscilloscope probe lead several times around a large-diameter ferrite toroid. This will act as a balun, or common mode inductor. It increases common mode impedance without significantly increasing differential mode impedance.

- Isolate the oscilloscope power source from the line voltage with an isolation transformer, or

- Wrap the power source AC line cord several times around a large-diameter ferrite toroid. This also reduces common mode current.

- Try using another oscilloscope and/or probe

PRECAUTIONS

Do not use the ground lead clipped to most common oscilloscope probes. The loop of wire itself will pick up high frequency radiated noise and give erroneous readings.

AP10 THERMAL CONSIDERATIONS

GENERAL CONSIDERATIONS

Thermal management is an important part of the system design process. The superior designs of RO's modules make thermal management relatively easy. Their high conversion efficiency minimizes the necessary cooling while their small package sizes with large thermal interfaces allow simultaneous reductions in system size and cost, along with substantial improvements in reliability. This application note presents some guidelines for good thermal design of systems using RO converters.

MODULE LOSSES

AC-DC and DC-DC modules convert power from an input source into regulated power suitable for the given application. While RO's conversion efficiencies are high, they are not perfect, and some of the input power is lost as heat in the module; which can be calculated from the following equations:

$$P_{MOD} = P_{OUT} \times \left(\frac{1}{\eta} - 1 \right)$$

This equation is derived from the definition of efficiency:

$$\eta = \frac{P_{OUT}}{P_{IN}}$$

The very first step in all thermal management designs is to estimate the worst case power dissipation. This can be estimated from the module efficiency graphs given in the catalog; or for conditions not covered by the graphs, it can be directly measured.

HEAT REMOVAL

MECHANISMS OF TRANSFER

Heat is removed from RO converters through the module's baseplate. The baseplate is thermally coupled to and electrically isolated from all internal components. The goal of good thermal design is to transfer heat from the baseplate to the outside world; thereby keeping the baseplate temperature below the maximum rating.

Heat energy is transferred from warm objects to cold objects by three fundamental means:

Convection: The transfer of energy through a liquid or gaseous media.

Conduction: The transfer of energy through a solid media.

Radiation: The transfer of energy between masses at different temperatures via predominantly infrared wavelengths.

While all three transfer mechanisms will be present in every application, convection is the dominant means of heat transfer in most. However, some consideration should be given to all three transfer means to ensure the cooling design is successful.

BASEPLATE TO HEATSINK INTERFACE

In many applications, heat will be conducted from the module to a heatsink, which is then cooled via one of the three mechanisms mentioned above. The interface between the heatsink and the baseplate can be modeled as a "thermal resistance" in series with the dissipated power flow. The temperature differential across the interface can be considerable if appropriate measures are not taken. These measures include controlling the flatness of the two surfaces and using a filler material such as thermal compound or Grafoil®. With proper care, the thermal resistance across the interface can be less than 0.8 °C·in^2/Watt; which for a 3.6" x 2.4" module is less than 0.09°C/Watt.

CONVECTION COOLING

Convection cooling is by far the most popular form of cooling used. In a convection cooled system the heat energy is transferred from the module to a nearby body of air either by direct contact or via a heatsink attached to the module baseplate. The thermal model for convection cooling is shown in Figure 10a. The baseplate temperature depends on the internal power dissipation, the total thermal resistance from the baseplate to the ambient air, and the ambient air temperature. The interface resistance can be minimized as discussed previously. The heatsink-to-air resistance is dependent on a variety of factors including heatsink material, geometry, and surface finish; as well as air temperature, air density, and air flow rate. Fortunately, thermal resistance data is available for a very wide range of standard heatsinks (from RO, Aavid, Thermaloy, and others) for use in convection cooled applications. Convection cooling is usually classified into two types: natural convection, and forced air convection.

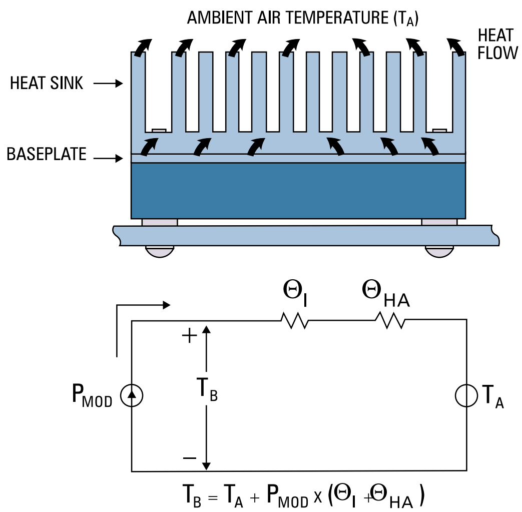


Figure 10a: *Thermal model for convection cooled systems.*

Natural convection, also referred to as free air convection, operates on the principle that air becomes less dense and rises when it is heated. Cooler more dense air then moves in to take its place and remove additional heat. Free air convection only works well when there is an unobstructed path for the air to flow. Since the hot air rises vertically the module and heatsink fins must be properly oriented in the vertical direction to maximize airflow. The advantages of free air convection cooling over forced air cooling include a lower implementation cost (no fans), and higher cooling system reliability. The heatsink volume, however, will have to be larger to achieve the same baseplate temperature as with forced air convection.

Forced air convection can make a big difference in cooling effectiveness. With a suitable heatsink, the heatsink-to-air thermal resistance can be improved by as much as an order of magnitude when compared to natural convection performance. Forced air implies the use of fans. In many applications, fans must be used to achieve some desired combination of overall system reliability and packaging density. In other applications, however, fans can't be considered because "dirty" environments require filters which must be changed regularly to maintain cooling efficiency. Neglecting to change a filter, or a failure of the fan may cause the system to shut down.

The process for selecting natural convection and forced convection heatsinks are essentially the same. For forced air systems, however, a fan must also be selected to create the required airflow, and the airflow must be channeled so that maximum cooling is achieved.

To calculate the required heatsinking:

1. Determine the worst case power to be dissipated. This should be based upon converter efficiency and worst-case converter power output using the formula given in the section on Module Losses.

2. Determine the thermal resistance from the module to the heatsink. An estimate of 0.8 °C·in^2/Watt should provide adequate safety margin. For more accuracy, experimentally measure the interface resistance for your application.

AP10 THERMAL CONSIDERATIONS

CONTINUED

3. Determine the required thermal resistance from the heatsink to the ambient air. Referencing Figure 10a, we can derive the following formula for heatsink-to-ambient thermal resistance:

$$\Theta_{HA} = \left(\frac{T_B - T_A}{P_{MOD}} \right) - \Theta_I$$

where:

$\Theta_{HA} =$ Maximum acceptable Heatsink-to-ambient thermal resistance

$\Theta_I =$ Thermal resistance of the interface between the heatsink and the base plate determined in step 2

$P_{MOD} =$ Module power dissiption, determined in step 1

$T_A =$ Worst case anticipated operating ambient air temperature

$T_B =$ Maximum desired baseplate temperature, up to 100°C.

4. For forced air systems estimate the airflow through the heatsink. This is a non-trivial task and is some-what iterative with step 5 because the heatsink selected will create back-pressure and will affect the airflow. To convert CFM fan data to LFM use the following formula:

$$LFM = \frac{CFM}{Area_{HS}}$$

Keep in mind that only the air that flows between the fins contributes to the cooling of the module.

5. Select a heatsink that meets the thermal resistance, cost, and physical dimension constraints. Keep in mind that every degree that the baseplate temperature is lowered results in significant improvements in the module reliability. You should therefore select the heatsink with the lowest possible thermal resistance within your constraints. Table 10a shows the thermal resistance of RO's heatsinks.

Alternatively, steps 4 and 5 can be done in the opposite order if your heatsink constraints are more severe than your fan constraints, i.e. you can select the heatsink first, and then pick a fan to get the necessary airflow.

6. Estimate the baseplate temperature using the following formula:

$$T_B = T_A + P_{MOD} \times \left(\Theta_I + \Theta_{HA} \right)$$

7. Verify the design via measurement. This is the most important step in the design process.

RO #	free air (°C/W)	200 LFM (°C/W)	400 LFM (°C/W)
2003	2.9	2.4	1.6
2005	2.2	1.8	1.2
2006	2.0	1.5	1.0

Table 10a: *Thermal resistances of RO heatsinks*

When designing the cooling system keep the following in mind:

- Heatsink data for natural convection is almost always given for vertical fin orientation. Orienting the fins in any other direction will impede the airflow and degrade the cooling effectiveness significantly. If you can't use the preferred orientation then get relevant heat sink performance data from the manufacturer.

- Natural convection depends on air movement caused by air density changes. The manufacturer's thermal resistance data depends on unobstructed air movement in-between and around the fins. If the air movement will be blocked or otherwise affected by the packaging then a larger heatsink may be required. In some cases, natural convection cooling may not be useable.

- Radiation cooling can be a significant contributor to natural convection cooled systems. Maximize radiation cooling by using an appropriate finish on the heatsink, such as black anodize.

- It is not necessary for the heatsink to be the same size as the baseplate. Heatsinks that are larger than the baseplate can often be used advantageously. Especially in applications where the fin height may be limited. When using heatsinks that are larger than the baseplate, select one that has a thick base for better conduction to the outer fins and derate the manufacturer's thermal resistance slightly.

- Several modules can be mounted to a common heatsink, but cooling calculations must now take into account the total power dissipation of all the modules. Give consideration to the possibility of localized overheating if the power dissipation isn't uniformly distributed.

TIPS ON MODULE PLACEMENT

Here are some tips to consider when laying out the system and placing the modules on the PWB:

- Always ensure that the module and heatsink interfacing surfaces are flat, smooth, clean, and free of debris

- Always use a void filling material such as thermal compound, thermal pads, or some other thermally conductive, conformable or malleable material. RO offers precut thermal pads made from GRAFOIL, material. Note: thermal pads are pre-installed on all heatsinks purchased from RO.

- Stagger the modules on the PWB to promote good air flow, to minimize thermal interaction between modules, and to facilitate even heat distribution.

- Avoid blocking the air flow to the modules with other components.

- Use a heatsink with the fins running in the direction of the air flow. For natural convection systems the air will flow upward in a vertical direction.

THERMAL EQUATION SUMMARY

Maximum Baseplate Temperature:

$$T_{max} = 100\ °C$$

Efficiency:

$$\eta = \frac{P_{OUT}}{P_{IN}}$$

Airflow:

$$LFM = \frac{CFM}{Area_{HS}}$$

Module Power Dissipation:

$$P_{MOD} = P_{OUT} \times \left(\frac{1}{\eta} - 1\right)$$

Max. Heatsink Impedance:

$$\Theta_{HA} = \left(\frac{T_B - T_A}{P_{OUT}\left(\frac{1}{\eta} - 1\right)}\right) - \Theta_I$$

Max.Output Power

$$P_{OUT} = \left(\frac{T_B - T_A}{(\Theta_{HA} + \Theta_I)\left(\frac{1}{\eta} - 1\right)}\right)$$

Baseplate Temperature:

$$T_B = T_A + P_{MOD} \times \left(\Theta_I + \Theta_{HA}\right)$$

AP10 THERMAL CONSIDERATIONS

CONTINUED

EXAMPLES

A µV48-5 module is being operated with 30A of load current in an ambient of 30 °C. From the efficiency graph in the catalog it has an efficiency of 82%. The module's losses are then:

$$P_{MOD} = 30A*5V*\left(\frac{1}{0.82} - \right) \approx 33W$$

The desired baseplate temperature is 75 °C and a conservative estimate of the interface thermal resistance is 0.2 °C/W. We therefore need a heatsink with a thermal resistance of:

$$\Theta_{HA} = \left(\frac{75°C - 30°C}{33W}\right) - 0.2°C/W$$

$$\Theta_{HA} \approx 1.2°C/W \text{ or less}$$

From the catalog we see that the RO 2005 heatsink has a thermal resistance of 1.0 °C/W with 400 LFM of air flow. The resulting design will operate at a baseplate temperature of:

$$T_B = 30\ °C + 33W \times (1.0\ °C/W + 0.2\ °C/W)$$

$$T_B \approx 70°C$$

PRECAUTIONS

Observe Max. Temperature Ratings
While the modules will protect themselves if the maximum baseplate temperature rating is exceeded, operating above the rating for extended periods of time can reduce the reliability of the module.

Don't Compress PC Board Material
Don't allow the mounting screws for the modules to exert compressive force on the PWB. The PWB material, typically G-10 or FR-4, will cold flow away from the screw and release the screw tension. The result can be a loss of heatsinking. See Application Note 19, Hole Dimensions and Socket Information, for further information.

RELATED TOPICS

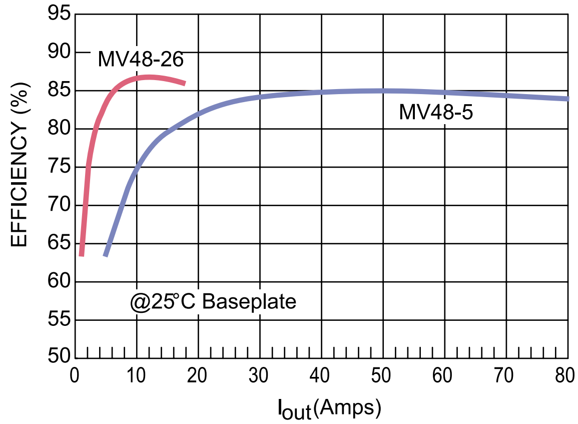
AP-2 Mechanical Mounting Considerations

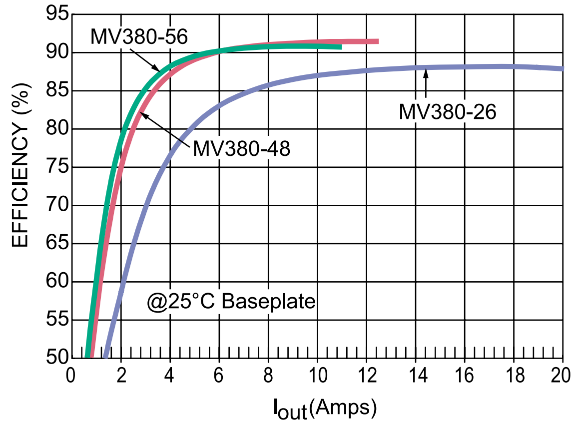
AP-18 Board Layout Considerations and Recommendations

AP-19 Hole Dimensions and Socket Information

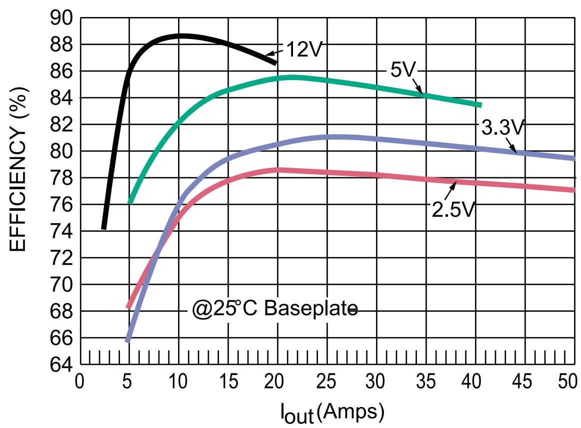
EFFICIENCY CURVES
CONTINUED

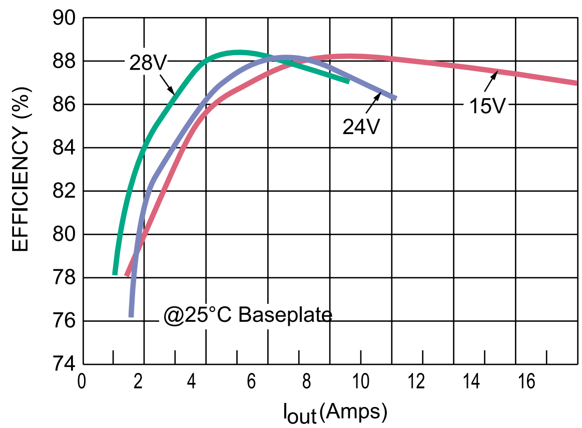
MEGAVERTER SERIES



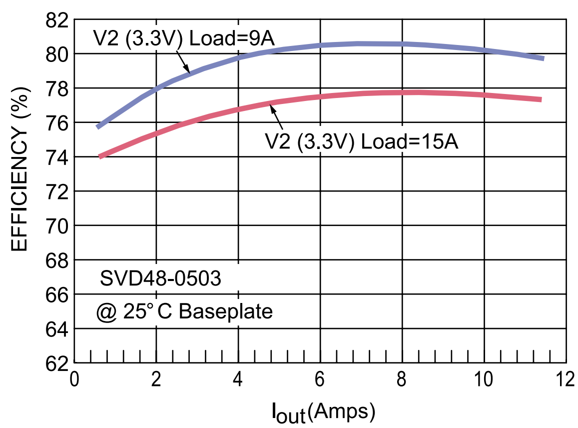


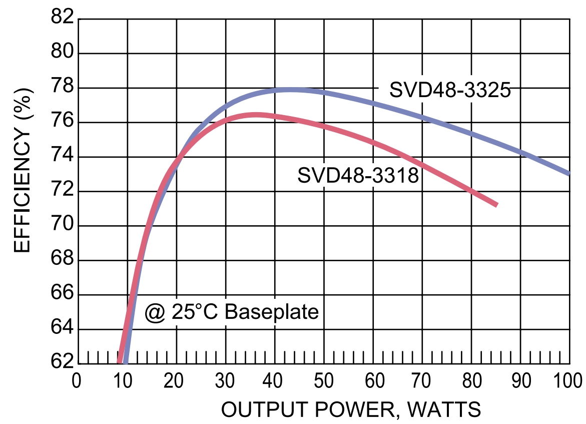
SUPERVERTER SERIES





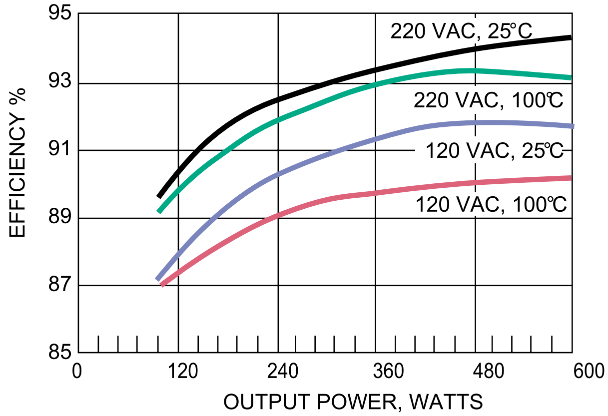
SUPERVERTER DUAL SERIES



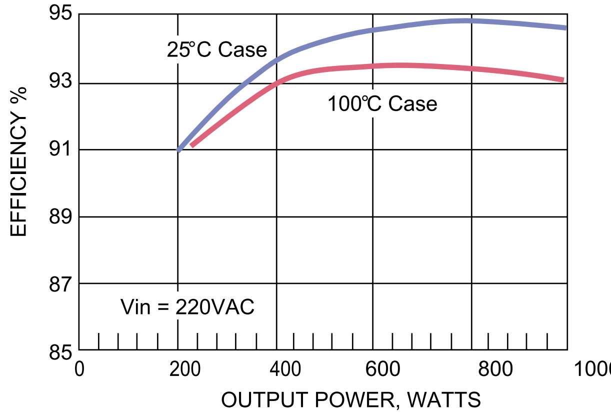


UNIVERTER SERIES

Efficiency PFC – 600

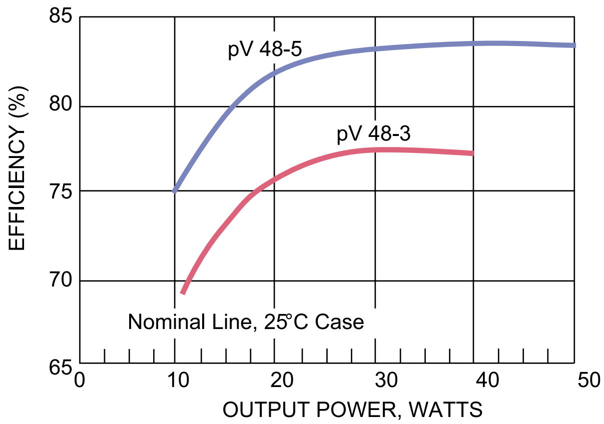


Efficiency PFC – 1000

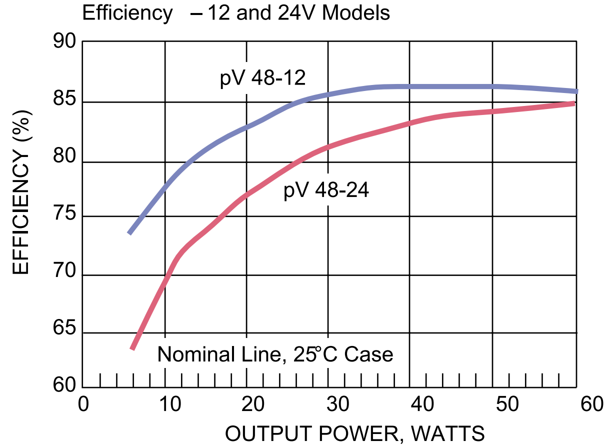


PICOVERTER SERIES

Efficiency – 3 and 5V Models

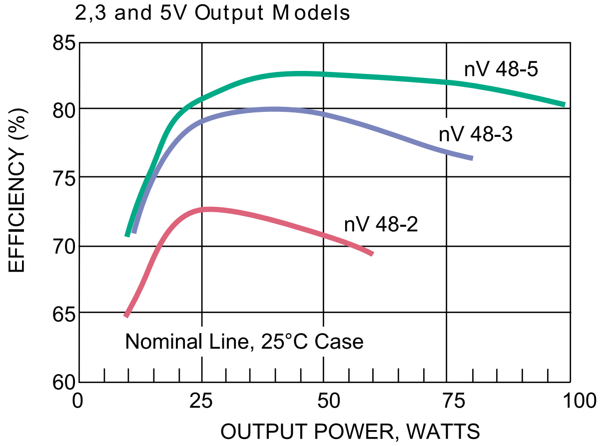


Efficiency – 12 and 24V Models

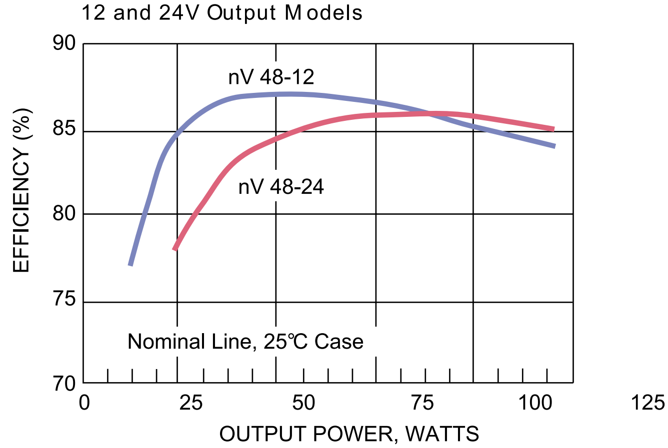


NANOVERTER SERIES

2,3 and 5V Output Models



12 and 24V Output Models

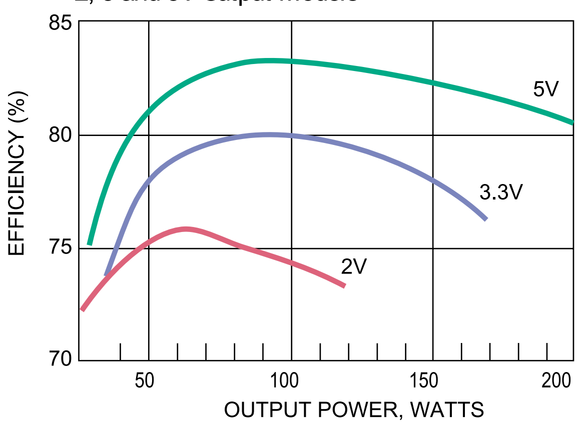


EFFICIENCY CURVES

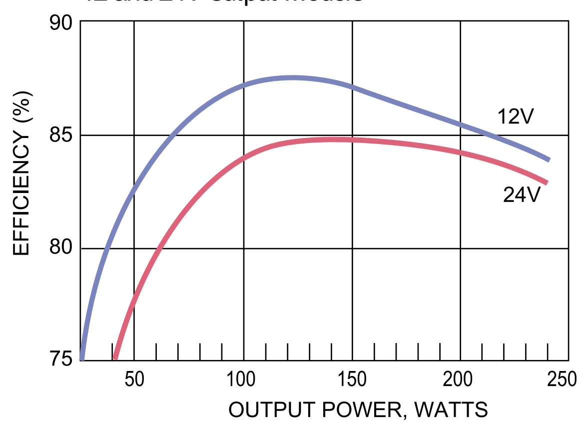
CONTINUED

MICROVERTER SERIES

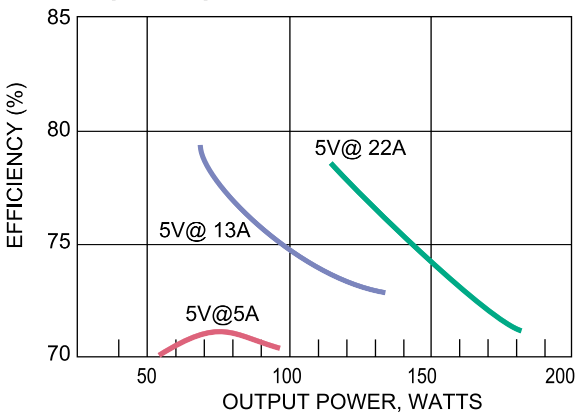
2, 3 and 5V Output Models



12 and 24V Output Models

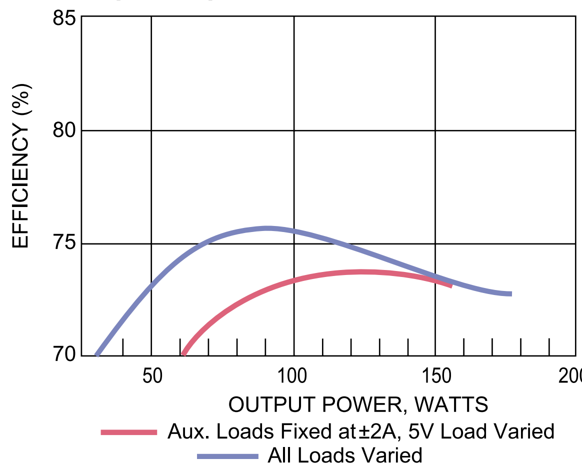


Triple Output Models



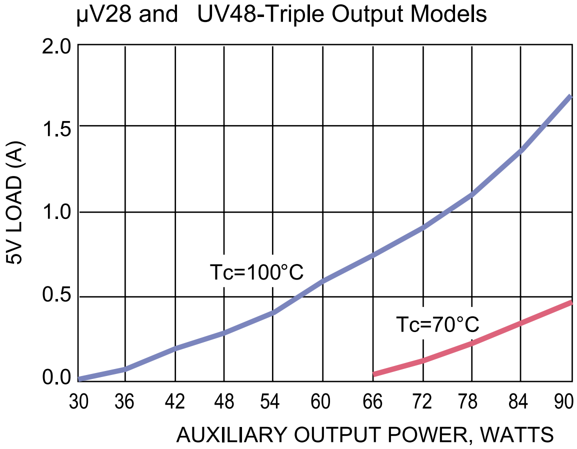
5V Load Fixed, Aux. Output Loads
Varied From 0 to 3A Each

Triple Output Models

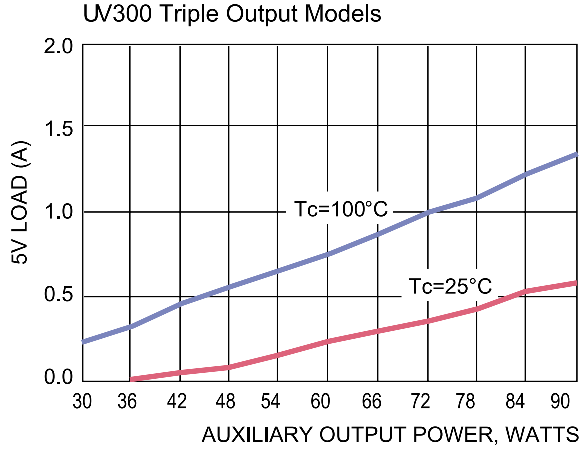


MINIMUM LOAD –TRIPLES

Minimum 5V Load vs. Auxiliary Output Power
µV28 and UV48-Triple Output Models



Minimum 5V Load vs. Auxiliary Output Power
UV300 Triple Output Models



Note: Efficiencies are typical for Tc=25°C and Nominal Input. Input and Output Voltages are measured at the Pins.

FREQUENTLY ASKED QUESTIONS

Included here are answers to some of the questions that our customers ask most frequently.

Q: What is the PWB footprint for the RO modules?

A: RO's modules are generally smaller than our competition's modules. The basic, recommended PWB footprints for our modules are shown in Application Note 19, *Hole Dimensions and Socket Information.* In addition, the outline drawings included in the product data sheets are another good source of information for creating custom PWB footprints.

Q: How much heatsinking do I need for the RO converters?

A: The amount of heatsinking required is determined by the environment that the module is placed in, the heat produced in the module, and the maximum desired baseplate temperature. Because RO's modules are highly efficient the required heatsinking is minimal. It may even be possible to operate the modules without any additional heatsinking. The thermal performance curves in this catalog were designed so that you can quickly determine the amount of heatsinking required for your application. A more in-depth discussion of thermal design with the RO modules is available in Application Note 10, *Thermal Considerations.*

Q: Why is a 1W, 6.2V Zener diode recommended on the Parallel Pin?

A: The Zener diode is recommended for any application that can see more than 6V, induced or applied, on the Parallel Pin. Accidental shorting of the Parallel Pin to a voltage greater than 6V will cause the module to fail. A 1W, 6.2V Zener diode will protect against most incidental shorts that occur during module testing as well as most externally induced transients that occur during operation.

Q: Why do I see 1V spikes on the output of the module?

A: These spikes do not really occur on the output, rather they are mostly the result of noise pickup and measurement error in the test setup used. A common source of noise pickup is the loop created by the ground clip on most standard scope probes. Application Note 8, *Noise and Ripple Measurement,* discusses how to properly measure the output noise and ripple.

Q: Can RO modules be used with no additional components?

A: Yes, in some applications they can. However, bypass capacitors are often required to reduce system noise and achieve proper module performance. For basic systems, we recommend that pads and traces for the components shown in Figure 1 be included in the initial PWB layout. The design team can then either optimize them for performance or, if performance is good, eliminate them for cost reduction.

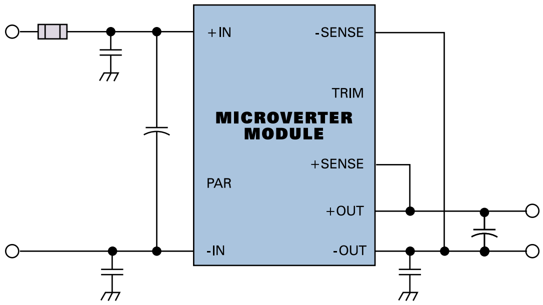


Figure 1

Q: Paralleling De-coupling Modules (PDMs) are great when redundancy is required, but can the RO modules be paralleled without PDMs?

A: Yes, RO modules can be paralleled without any external components other than bypass and storage capacitors when redundancy is not required. An exception to this, however, is the 300V MICROVERTER series; which requires a disconnect circuit to ensure an orderly startup. *See Application Note 11 for more information.*

FREQUENTLY ASKED QUESTIONS

CONTINUED

Q: What is the recommended solder process for the modules?

A: The recommended solder process is a wave solder process with the solder wave at 260°C. Each pin should be in the wave for 5 seconds and the big pins should enter the wave last. Because the modules have a high thermal mass, the preheat cycle must be lengthened in order for proper solder wetting of the pins to occur.

Q: Why do the modules sometimes seem to current limit to early?

A: Noise on the Parallel Pin, the Input Pins, or the Output Pins can cause premature current limit in the modules. Application Note 13 *Paralleling- Current Sharing, Hot Plug-in, and N+M Redundancy* and Application Note 18 *Board Layout Considerations and Recommendations* provide some preventative and corrective measures that can be taken to reduce the noise. Adding the proper bypass caps to these pins will usually solve the problem.

Q: Why does the output noise increase when I connect the output return lines of the triple output module together?

A: As with most multiple output power supplies, common mode noise can be injected from one output into another causing increased noise. Adding a small, common mode choke of about 25µH per leg to each auxiliary output, before the common ground connection, will prevent this from occurring. *See Application Note 14 for more information.*

Q: How does the output good signal function?

A: The output good signal provides an active low output whenever the sensed output voltage is within ±10% of the set output voltage;otherwise it appears as an open collector (Vmax = 40V). The signal is referenced to -SENSE (See Figure 2) and is capable of sinking 15mA typical (8mA minimum). The output low voltage (saturation voltage) is 0.5V or less @ Isink = 1.6mA. The output good signal changes its state in the range Vsense = ±9% to ±11% of Vsetpoint.

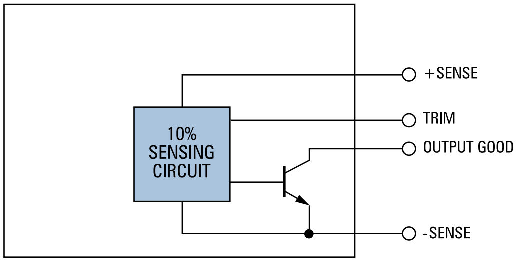


Figure 2: *Equivalent circuit of the Output Good Signal*

Q: How do I use the ON/OFF pin?

A: The ON/OFF pin may be used to turn the module off and on remotely using a low level signal. When ON/OFF is pulled low (<1V @4mA, referenced to -Vin), the module is turned off. All that is required to interface the ON/OFF signal to the other circuits is a few external components as shown in Figure 3. Additional ways to use the ON/OFF pin are shown in Application Note 4, *Logic On-Off.*

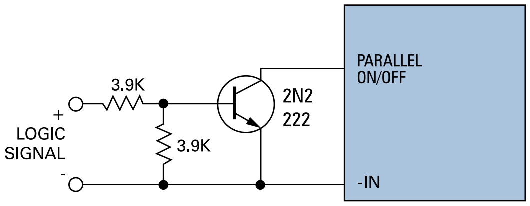


Figure 3: *Logic on/off circuit with small signal transistor. A logic high signal disables the converter.*

GLOSSARY

Apparent Power: The product of RMS voltage and RMS current.

Brownout: A drop or sag of the input voltage below a converter's rated input range.

Current Limit: The point where the operation of a converter changes from constant voltage mode to constant current mode.

Current Sharing: Equal division of the total load current between two or more modules.

Efficiency: The ratio of output power divided by input power, expressed as a percentage.

Fault Tolerance: The capability of a power supply system to sustain one or more faults without degrading the power to the load.

Input Over Voltage: An increase or surge of the input voltage above a converter's rated input range.

Input Reflected Ripple: The AC component of the input current of a converter resulting from the converter's operation (high frequency switching), expressed as a percentage of the DC component.

Input Ripple Rejection: The attenuation of AC ripple a converter provides from its input to its output, expressed in dB.

Inrush Charge: The amount of charge, in Coulombs, that will flow into a converter upon application of nominal input voltage.

Isolation Voltage: The voltage that can be applied between related circuits of a device without voltage break down occurring in the insulation between them.

Line Regulation: The change in a converter's output voltage resulting from a predefined change in the input voltage, expressed as a percentage of the output voltage.

Load Regulation: The change in a converter's output voltage resulting from a predefined change in the load current, expressed as a percentage of the output voltage.

Minimum Load: The minimum load current required for a converter to operate within specification.

Non-Shutdown Over Voltage Protection: The feature of a converter to continue supplying voltage to a load at a prescribed upper limit without shutting down and without requiring reset when the event causing the over voltage condition is over.

Output Current Rating: The maximum current at which a converter will operate reliably and within its specifications.

Power Factor: The ratio of true input power to apparent input power in an AC input system.

Redundancy: The connection of multiple converters to provide uninterrupted power to the load in the event of a converter failure.

Remote Sense Compensation: The amount of voltage drop that a converter can compensate for between the output of the converter and the sense point on the load.

Short-Circuit Current: The maximum output current that a converter will source with its output shorted, expressed as a percentage of the rated current.

Thermal Protection: The feature of a converter to protect itself, usually by shutting down, when its internal temperature reaches a prescribed maximum safe level.

Transient Response: The response of a converter's output voltage to a defined, abrupt change in either the output current or the input voltage.

Turn-on Time: The time a converter takes to begin operating within specification after proper power has been applied.

MODEL NUMBER INDEX

SKU	Product Description
S2003LF	Heatsink, nV & pV modules
2005LF	Heatsink, µV Singles
2006LF	Heatsink, full brick modules
2021LF	Heatsink, half brick, 1.4 ht., L fins(S-S)
2024LF	Heatsink, half brick, 0.45 ht., W fins(I-O)
2025LF	Heatsink, half brick, 0.45 ht., L fins(S-S)
9528LF	Standoff, swage, #4 thru
9603LF	Thermal Interface Pad, half brick modules
9604LF	Thermal Interface Pad, µV Singles
9605LF	Thermal Interface Pad, full brick modules
9608LF	Thermal Interface Pad, nV & pV modules
9740LF	Socket for .060 dia. pin
9741LF	Socket for .025 sq. pin
9748LF	Socket for .080 dia. pin
9871LF	Socket for .040 dia. pin
9872LF	Socket for .138 dia. pin
9878LF	Standoff, swage, #6 thru
9890LF	Socket for .040 dia. pin
9894LF	Socket for .100 dia. pin
ASD75-24S12Q	DC-DC Converter, 24V in, 12V out, 6.5A
ASD75-24S15Q	DC-DC Converter, 24V in, 15V out, 5.0A
ASD75-24S24Q	DC-DC Converter, 24V in, 24V out, 3.13A
ASD75-24S3.3Q	DC-DC Converter, 24V in, 3.3V out, 20A
ASD75-24S5Q	DC-DC Converter, 24V in, 5V out, 15A
ASD75-48S12Q	DC-DC Converter, 48V in, 12V out, 6.5A
ASD75-48S15Q	DC-DC Converter, 48V in, 15V out, 5.0A
ASD75-48S24Q	DC-DC Converter, 48V in, 24V out, 3.13A
ASD75-48S3.3Q	DC-DC Converter, 48V in, 3.3V out, 20A
ASD75-48S5Q	DC-DC Converter, 48V in, 5V out, 15A
ASD100-24S12W	DC-DC Converter, 24V in, 12V out, 8.33A
ASD100-24S15W	DC-DC Converter, 24V in, 15V out, 6.67A
ASD100-24S24W	DC-DC Converter, 24V in, 24V out, 4.13A
ASD100-24S3.3W	DC-DC Converter, 24V in, 3.3V out, 25A
ASD100-24S5W	DC-DC Converter, 24V in, 5V out, 20A
ASD100-48S12W	DC-DC Converter, 48V in, 12V out, 8.33A
ASD100-48S15W	DC-DC Converter, 48V in, 15V out, 6.67A
ASD100-48S24W	DC-DC Converter, 48V in, 24V out, 4.13A
ASD100-48S3.3W	DC-DC Converter, 48V in, 3.3V out, 25A
ASD100-48S5W	DC-DC Converter, 48V in, 5V out, 20A
ASD150-24S12W	DC-DC Converter, 24V in, 12V out, 12.5A
ASD150-24S15W	DC-DC Converter, 24V in, 15V out, 10A
ASD150-24S24W	DC-DC Converter, 24V in, 24V out, 6.26A
ASD150-24S3.3W	DC-DC Converter, 24V in, 3.3V out, 30A
ASD150-24S5W	DC-DC Converter, 24V in, 5V out, 30A
ASD150-48S12W	DC-DC Converter, 48V in, 12V out, 12.5A
ASD150-48S15W	DC-DC Converter, 48V in, 15V out, 10A
ASD150-48S24W	DC-DC Converter, 48V in, 24V out, 6.26A
ASD150-48S3.3W	DC-DC Converter, 48V in, 3.3V out, 30A
ASD100-48S5W	DC-DC Converter, 48V in, 5V out, 30A
ASD150-24S12QB	DC-DC Converter, 24V in, 12V out, 20A
ASD150-24S3.3QB	DC-DC Converter, 24V in, 3.3V out, 45A
ASD150-24S5QB	DC-DC Converter, 24V in, 5V out, 30A
ASD150-48S12QB	DC-DC Converter, 48V in, 12V out, 20A
ASD150-48S3.3QB	DC-DC Converter, 48V in, 3.3V out, 45.45A

SKU	Product Description
ASD150-48S5QB	DC-DC Converter, 48V in, 5V out, 30A
ASD240-24S12W	DC-DC Converter, 24V in, 12V out, 20A
ASD240-24S15W	DC-DC Converter, 24V in, 15V out, 16A
ASD240-24S24W	DC-DC Converter, 24V in, 24V out, 10A
ASD240-24S28W	DC-DC Converter, 24V in, 28V out, 8.6A
ASD240-24S48W	DC-DC Converter, 24V in, 48V out, 5A
FB100-10	EMI Filter, DC-DC, 100Vdc, 10A
FB50-15	EMI Filter, DC-DC, 50Vdc, 15A
FB50-20	EMI Filter, DC-DC, 50Vdc, 20A
FA250-5	EMI Filter, PFC, 250Vac, 5A
FA250-6	EMI Filter, PFC, sMV 250Vac, 6A
HH-1199-6	EMI Filter, PFC, 250Vac, 6A
MB300-S-SKT	Mounting Board, Socketed, µV300 Singles
MB300-T-SKT	Mounting Board, Socketed, µV300 Singles
MB-S-SKT	Mounting Board, Socketed, µV28 & µV48 Singles
MB-T-SKT	Mounting Board, Socketed, µV28, µV48 Singles
MV24-28-600	DC-DC Converter, 24V in, 28V out, 21.5A
MV380-26	DC-DC Converter, 380V in, 26V out, 20A
MV380-28-700	DC-DC Converter, 380V in, 28V out, 25A
MV48-28-700	DC-DC Converter, 48V in, 28V out, 25A
nV300-12	DC-DC Converter, 300V in, 12V out, 10A
nV300-15	DC-DC Converter, 300V in, 15V out, 8A
nV300-24	DC-DC Converter, 300V in, 24V out, 5A
nV300-3	DC-DC Converter, 300V in, 3.3V out, 25A
nV300-5	DC-DC Converter, 300V in, 5V out, 20A
PDM	Parallel Decoupling Module
PFC-1000	AC-DC Converter, PFC, 1000W,
PFC-600	AC-DC Converter, PFC, 600W,
PFC-650	AC-DC Converter, PFC, 650W,
PFC-375	AC-DC Converter, PFC, 375W,
PFC-180	AC-DC Converter, PFC, 180W,
pV300-12	DC-DC Converter, 300V in, 12V out, 5A
pV300-15	DC-DC Converter, 300V in, 15V out, 4A
pV300-24	DC-DC Converter, 300V in, 24V out, 2.5A
pV300-3	DC-DC Converter, 300V in, 3.3V out, 12.5A
pV300-5	DC-DC Converter, 300V in, 5V out, 10A
SMV-28-500	DC-DC Converter, 300V in, 28V out, 18A
SMV-48-500	DC-DC Converter, 300V in, 48V out, 10.5A
SMV-12-500	DC-DC Converter, 300V in, 12V out, 42A
SV24-12-300-1	DC-DC Converter, 28V in, 12V out, 25A
SV24-24-300-1	DC-DC Converter, 28V in, 24V out,12.5A
SV24-28-350-1	DC-DC Converter, 28V in, 28V out, 12.5A
SV24-32-400-1	DC-DC Converter, 28V in, 32V out, 12.5A

SKU	Product Description
SV28-12-150-1	DC-DC Converter, 28V in, 12V out, 12.5A
SV28-12-200-1	DC-DC Converter, 28V in, 12V out, 12.5A
SV28-24-150-1	DC-DC Converter, 28V in, 24V out, 12.5A
SV28-24-200-1	DC-DC Converter, 28V in, 24V out, 8.3A
SV28-28-150-1	DC-DC Converter, 28V in, 28V out, 5.35A
SV28-28-200-1	DC-DC Converter, 28V in, 28V out, 7.1A
SV28-3-150-1	DC-DC Converter, 28V in, 3.3V out, 30A
SV28-3-200-1	DC-DC Converter, 28V in, 3.3V out, 40A
SV28-5-150-1	DC-DC Converter, 28V in, 5V out, 30A
SV28-5-200-1	DC-DC Converter, 28V in, 5V out, 40A
SV28-5-175-1	DC-DC Converter, 28V in, 5V out, 35A
uV24-5-164	DC-DC Converter, 24V in, 5Vout, 20A
uV24-8-164	DC-DC Converter, 24V in, 8V out, 36A
uV24-12-164	DC-DC Converter, 24V in, 12V out, 25A
uV24-15-164	DC-DC Converter, 24V in, 15V out, 20A
uV24-24-164	DC-DC Converter, 24V in, 24V out, 12.5A
uV24-28-164	DC-DC Converter, 24V in, 28V out, 11A
uV28-12	DC-DC Converter, 28V in, 12V out, 20A
uV28-15	DC-DC Converter, 28V in, 15V out, 16A
uV28-24	DC-DC Converter, 28V in, 24V out, 10A
uV28-28	DC-DC Converter, 28V in, 28V out, 9A
uV28-3	DC-DC Converter, 28V in, 3.3V out, 50A
uV28-5	DC-DC Converter, 28V in, 5V out, 40A
uV28-8	DC-DC Converter, 28V in, 8V out, 30A
uV28-T512	DC-DC Converter, 28V in, 5V, ±12V, 185W
uV28-T515	DC-DC Converter, 28V in, 5V, ±15V, 185W
uV300-12	DC-DC Converter, 300V in, 12V out, 20A
uV300-15	DC-DC Converter, 300V in, 15V out, 16A
uV300-24	DC-DC Converter, 300V in, 24V out, 10A
uV300-28	DC-DC Converter, 300V in, 28V out, 9A
uV300-3	DC-DC Converter, 300V in, 3.3V out, 50A
uV300-5	DC-DC Converter, 300V in, 5V out, 40A
uV300-5-164	DC-DC Converter, 300V in, 5Vout, 20W
uV300-8	DC-DC Converter, 300V in, 8V out, 30A
uV300-8-164	DC-DC Converter, 300V in, 8V out, 36A
uV300-12-164	DC-DC Converter, 300V in, 12V out, 25A
uV300-15-164	DC-DC Converter, 300V in, 15V out, 20A
uV300-24-164	DC-DC Converter, 300V in, 24V out, 12.5A
uV300-28-164	DC-DC Converter, 300V in, 28V out, 11A
uV300-T512	DC-DC Converter, 300V in, 5V, ±12V, 185W
uV300-T515	DC-DC Converter, 300V in, 5V, ±15V, 185W
uV48-12	DC-DC Converter, 48V in, 12V out, 20A
uV48-8	DC-DC Converter, 48V in, 8V out, 30A
uV48-12-164	DC-DC Converter, 48V in, 12V out, 25A
uV48-8-164	DC-DC Converter, 48V in, 8V out, 36A

SKU	Product Description

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75 Watt ASD-Q Single Series DC/DC Converters

Description

The 75 Watt single ASD-Q series of DC/DC Converters provide precisely regulated dc outputs. All outputs are fully isolated from the inputs, allowing the output to be used with positive or negative polarity and various grounding options. The ASD-Q Series utilizes an insulated metal substrate design in an industry standard 1/4 brick case size to meet the most rigorous requirements of COTS and thermally challenging industrial applications.

Standard features include remote sensing, output trim, and remote on/off. Threaded-through holes are provided to allow easy mounting or add a heat sink for extended temperature use.

Features

- Small size 1.45"x2.28"x0.52", industry standard 1/4 brick
- Excellent thermal performance with metal baseplate
- High Efficiency
- Fast over voltage protection
- Pulse-by-pulse current limiting, dead short current limiting
- Over-temperature protection
- Auto-softstart
- Very Low noise
- Low profile magnetics run cooler
- Constant frequency for normal operation
- Wide input voltage range
- Remote Sense with high regulation
- Remote ON/OFF
- Super energy saving, 6 mA input idle current
- Output trim with very low temperature coefficient
- Water Washable, wide humidity applications
- Good shock and vibration damping

Selection Chart

Model	Input Range VDC		I in ADC @ nom	V out VDC	I out ADC
	Min	Max	Typ		
ASD75-24S3.3Q	18	36	3.31	3.3	20
ASD75-24S5Q	18	36	3.63	5	15
ASD75-24S12Q	18	36	3.59	12	6.25
ASD75-24S15Q	18	36	3.55	15	5
ASD75-24S24Q	18	36	3.55	24	3.13
ASD75-48S3.3Q	36	75	1.65	3.3	20
ASD75-48S5Q	36	75	1.80	5	15
ASD75-48S12Q	36	75	1.78	12	6.25
ASD75-48S15Q	36	75	1.76	15	5
ASD75-48S24Q	36	75	1.76	24	3.13

Default ON/OFF logic is positive.
Add -N to the model number to order negative ON/OFF logic.

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75 Watt ASD-Q Single Series DC/DC Converters

Unless otherwise stated, these specifications apply for ambient temperature T_A=23 ±2°C, nominal input voltage, and rated full load. (1)

Input Parameters							
Model		ASD75-24S3.3Q	ASD75-24S5Q	ASD75-24S12Q	ASD75-24S15Q	ASD75-24S24Q	**Units**
Voltage Range	MIN TYP MAX	18 24 36					VDC
Input Overvoltage* 100 mSec	MAX	50					VDC
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	50 3.3	50 3.6	50 3.6	50 3.6	50 3.6	mA A
Inrush Current	MAX	0.2					A^2S
Reflected Ripple, 12µH Source Impedance (3)	TYP	10					mA P-P
Efficiency	TYP	82	84	86	87	87	%
Switching Frequency	TYP	360					kHz
Recommended Fuse		(2)					AMPS

Input Parameters							
Model		ASD75-48S3.3Q	ASD75-48S5Q	ASD75-48S12Q	ASD75-48S15Q	ASD75-48S24Q	**Units**
Voltage Range	MIN TYP MAX	36 48 75					VDC
Input Overvoltage* 100 mSec	MAX	85					VDC
Input Ripple Rejection (120Hz)	TYP	60					dB
Undervoltage Lockout		Yes					
Input Reverse Voltage Protection		Yes					
Input Current No Load 100% Load	TYP TYP	80 1.7	80 1.8	80 1.8	80 1.8	80 1.8	mA A
Inrush Current	MAX	0.2					A^2S
Reflected Ripple, 12µH Source Impedance (3)	TYP	10					mA P-P
Efficiency	TYP	82	84	86	87	87	%
Switching Frequency	TYP	360					kHz
Recommended Fuse		(2)					AMPS

* Absolute Maximum Ratings. Caution: Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device (see Note 1).

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75 Watt ASD-Q Single Series DC/DC Converters

Unless otherwise stated, these specifications apply for ambient temperature T_A=23 ±2°C, nominal input voltage, and rated full load. (1)

Output Parameters							
Model		ASD75-24S3.3Q ASD75-48S3.3Q	ASD75-24S5Q ASD75-48S5Q	ASD75-24S12Q ASD75-48S12Q	ASD75-24S15Q ASD75-48S15Q	ASD75-24S24Q ASD75-48S24Q	**Units**
Output Voltage		3.3	5	12	15	24	VDC
Output Voltage Setpoint Accuracy	MAX	±1					%
Turn On Overshoot	TYP	0					%
Temperature Coefficient	TYP MAX	0.005 0.01	0.003 0.005				%/°C
Noise (8)	TYP	20	20	40	50	70	mV RMS
Ripple	TYP	30	30	75	100	150	mV P-P
Load Current (4)	MIN MAX	5 100					%
Load Transient Overshoot (7)	TYP	2					%
Load Transient Recovery Time (6)	TYP	0.8					mSec
Load Regulation (5) Min-Max Load	TYP MAX	0.02 0.2					%
Line Regulation Vin = Min-Max	TYP MAX	0.01 0.1					%
Overvoltage Protection (OVP) Threshhold OVP Type - Non-latching Open Loop Overvoltage Clamp	MIN MAX	115 135					%
Output Current Limit V out=90% of V out-nom	TYP	120					%
Output Short Circuit Current V out = 0.1 V	TYP MAX	150 160					%

NOTES:

(1) Refer to the Astrodyne Application Notes for the definition of terms, measurement circuits, and other information.

(2) Refer to the Astrodyne Application Notes for information on fusing. For inrush current, refer to the specifications above.

(3) 33 µF capacitor connected to two “Input” pins. Then place current sensor in series with 12 µH inductor between 33 µF and the source. The reflected ripple current is measured over 5 Hz to 20 MHz bandwidth (current sensor is located between the converter input pin and the 12 µH inductor).

(4) Optimum performance is obtained when this power supply is operated within the minimum to maximum load specifications. No damage to module will occur when the output is operated at less than minimum load, but the output voltage may contain a low frequency component that may exceed output noise specifications.

(5) Load regulation is defined as the output voltage change when changing load current from maximum to minimum. The voltage is measured at the output pin.

(6) Load Transient Recovery Time is defined as the time for the output to settle from a 50 to 75% or 25% step load change to a 1% error band of output voltage (rise time of step = 2µ Sec).

(7) Load Transient Overshoot is defined as the peak overshoot during a transient as defined in the Note 6 above.

(8) Noise is measured per the Astrodyne Application Notes. Output noise is measured with a 10 µF tantalum capacitor in parallel with a 0.1 µF ceramic capacitor connected across the output to CMN. Measurement bandwidth is 0-20 MHz.

(9) When an external On/Off switch is used, such as open collector switch, logic high requires the switch to be high-impedance. Switch leakage currents greater than 20 µA may be sufficient to trigger the On/Off to the logic-low state.

(10) Most switches would be suitable for logic On/Off control, in case there is a problem, you can make following estimation and then leave some margin.

When open collector is used for logic high, “Open Circuit Voltage at On/Off Pin”, “Output Resistance” and “External Leakage Current Allowed for Logic High” are used to estimate the high impedance requirement of open collector.

When switch is used for logic low, “Open Circuit Voltage at On/Off Pin”, “Output Resistance” and “LOW Logic Level” are used to estimate the low impedance requirement of switch.

(11) Thermal impedance is tested with the converter mounted vertically and facing another printed circuit board 1/2 inch away. If converter is mounted horizontally with no obstructions, thermal impedance is approximately 10 °C/W.

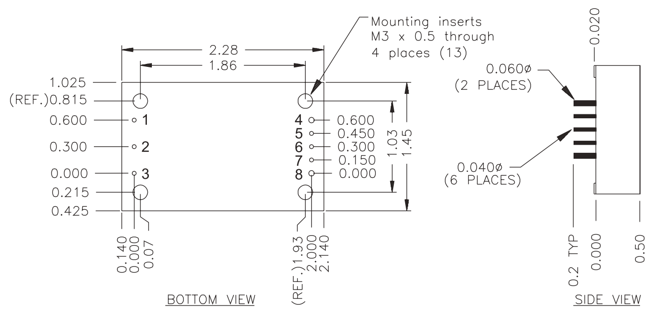
If heat sink is needed, apply a very thin layer of thermally conductive grease on the metal base of converter, then properly tighten the screws.

(12) Water Washability - These DC/DC converters are designed to withstand most solder/wash processes. Careful attention should be used when assessing the applicability in your specific manufacturing process. Converters are not hermetically sealed.

(13) Torque fasteners into threaded mounting inserts at 12 in. oz. or less. Greater torque may result in damage to unit and void the warranty.

75 Watt ASD-Q Single Series DC/DC Converters

General Specifications			
All Models			**Units**
Remote ON/OFF Function			
HIGH Logic Level or Leave ON/OFF Pin Open	MIN	3.0	VDC
External Leakage Current Allowed for Logic High (9)	MAX	20	µA
Input Diode Protection Voltage	MAX	50	VDC
LOW Logic Level or Tie ON/OFF Pin to -Input	MAX	1.0	VDC
Sinking Current for Logic Low	MAX	1	mA
Open Circuit Voltage at Primary ON/OFF Pin (10) Positive Logic Negative Logic	TYP TYP	5.6 1.5	VDC VDC
Idle Current (Module is OFF)	TYP	6	mADC
Turn-on Time to 1% error	TYP	8	mSec
Positive Logic Option	HIGH - Module ON LOW - Module OFF		
Negative Logic Option	HIGH - Module OFF LOW - Module ON		
Output Voltage Trim			
Trim Range	MIN MAX	±10	% of Vout
Input Resistance	TYP	10	k Ohm
Open Circuit Voltage	TYP	2.5	V
Output Voltage Remote Sensing			
Maximum Voltage Drops on Lead	MAX	0.5	VDC
Line Regulation under remote sensing	TYP MAX	0.02 0.1	%
Load Regulation under remote sensing	TYP MAX	0.05 0.2	%
Sense and Trim Limit			
Maximum Output Voltage	MAX	110	% of Vout
Isolation			
Input to Output Isolation* 10µA Leakage Vnom = 24 V models Vnom = 48 V models	 MAX MAX	 700 1544	 VDC VDC
Environmental			
Calculated MTBF, Bellcore Method 1, Case 1		>1,000,000	Hr
Baseplate Operating Temperature Range	MIN MAX	-40 100	°C
Storage Temperature	MIN MAX	-40 120	°C
Thermal Impedance (11)	TYP	9	°C/W
Thermal Shutdown Baseplate Temperature (Auto Restart)	MIN TYP	100 110	°C
General			
Case Dimension	2.28" x 1.45" x 0.50"		
Agency Approvals Pending	UL/CUL 60950		
Chassis Mounting Kit	MS18		
Torque on Mounting Inserts	MAX	12 in. oz.	



Mechanical tolerances unless otherwise noted:

X.XX dimensions: ±0.020 inches

X.XXX dimensions: ±0.005 inches

Pin	Function
1	-INPUT
2	ON/OFF
3	+INPUT
4	-OUTPUT
5	-SENSE
6	TRIM
7	+SENSE
8	+OUTPUT

* Absolute Maximum Ratings. Caution: Stresses in excess of the Absolute Maximum Ratings can cause permanent damage to the device (see Note 1).

Astrodyne RO
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150 Watt, High Efficiency, Quarter Brick DC/DC Converter **ASD150QB series**

- Industry Standard Quarter Brick Package
- High Power Density up to 90W/ Inch ^{3}
- High Typical Efficiency of 91%
- Low Output Noise
- Metal Baseplate
- Thermal Protection
- Input Under Voltage Protection
- Output Over Voltage Protection
- Current Limit/Short Circuit Protection
- Adjustable Output Voltage 90-110% of Vo
- Remote Sense
- Positive Remote ON/OFF Control (Negative Logic is Optional)
- RoHS Compliant

DESCRIPTION:
The ASD150QB dc/dc converter is offered in the industry standard “quarter brick” size (2.28in. x 1.45in. x 0.50in.) for circuit board mounting. It is designed for use in a 24/28 Vdc (18-36Vdc) or 48 Vdc (36-75Vdc) input applications where exceptionally high density DC power is required. The ASD150QB utilizes an insulated metal substrate and is therefore well suited for the most rigorous requirements of COTS and thermally challenging industrial applications.

Model Number	Output Voltage	Output Amps	Input Range	Max. Iin FL	Efficiency (Tb=25°C)	O/P Set Point	ISC (Hiccup)
ASD150-24S3.3QB	3.3 VDC	45	18-36 VDC	10A	91%	3.267-3.333V	45 Arms
ASD150-48S3.3QB	3.3 VDC	45.45	36-75 VDC	5A	91%	3.25-3.35V	45.45 Arms
ASD150-24S5QB	5 VDC	30	18-36 VDC	10A	91%	4.95-5.05V	30 Arms
ASD150-48S5QB	5 VDC	30	36-75 VDC	5A	92.5%	4.95-5.05V	30 Arms
ASD150-24S12QB	12 VDC	12.5	18-36 VDC	10A	91.5%	11.88-12.12V	20 Arms
ASD150-48S12QB	12 VDC	12.5	36-75 VDC	5A	92.5%	11.88-12.12V	20 Arms

All specifications are typical at nominal input, full load, and 25DegC unless otherwise noted

Astrodyne RO
Now you have power.

150 Watt, High Efficiency, Quarter Brick DC/DC Converter

ASD150QB series

ABSOLUTE MAXIMUM RATINGS (MIN TO MAX.)

Input Voltage (+In to -In)	
24Vin:	-0.3 to 36VDC (50VDC <100mS)
48Vin:	-0.3 to 75VDC (100VDC <100mS)
Logic ON/OFF Voltage	-0.3 to 5V (ON/OFF to -In)
Storage Temperature	-40 to +125°C
Storage Humidity	10 to 95%
Operating Temperature (Note 5)	-40 to 100°C
Operating Humidity	30 to 95%
Output Power	150 Watts

INPUT SPECIFICATIONS

Input Operation Voltage:	See Model Selection Chart PG. 1
Input Current FL @ Nom Vin, FL	See Model Selection Chart PG. 1
Inrush Transient	$1A^2s$
Input Reflected Ripple Current	40mAp-p, typ. (60mA max.)
Input Ripple Rejection	60dB@120Hz
Input Under Voltage Protection (24Vin/48Vin)	
Turn-on Threshold:	17.5-18V/34-36V max.
Turn-off Threshold:	15.5-16V/30-32V typ.
Hysteresis:	1-1.5V/2.0V typ.

OUTPUT SPECIFICATIONS

Output Voltage & Current	See Model Selection Chart PG. 1
Output Set Point (Vo,set; Note 6)	See Model Selection Chart PG. 1
Output Voltage Tolerance Band	+/-3%
Load/Load Regulation	20mV max.
Temperature Coefficient	+/-0.02%/°C, -40 to 100°C
Ripple/Noise p-p max. (Note 1)	3.3, 5Vo: 70mV; 12Vo: 120mV
Dynamic Response (Vo, Set):	6% max., Nom. Vin, Tb=25°C
	(Note 3)
Peak Deviation	300uS duration outside of Vo set
Settling Time	+/-1% error band
Over Voltage Protection	112-140% of Output, Io=0.5A
Over Temperature Protection	100-115°C, auto recover @ 90°C
	See Fig. 3 for location definition
External Capacitance	660 to 5000uF max.
Short Circuit Protection (ISC)	See Model Selection Chart PG. 1
Current Limit (Note 2)	105-145% of Rated Load
Efficiency (Nom. Vin, 80% Load)	See Model Selection Chart PG. 1

STRUCTURAL DYNAMICS

Vibration	(Note 4)
Shock	20g, 166in/sec, Square Wave

ISOLATION SPECIFICATIONS

Input-Output, Input-Case	1500VDC, 60S
Output-Case	500VDC, 60S
Input-Output Capacitance	2000pF
Isolation Resistance	100MΩ @ Tb=25°C & 70%RH
	Output to Baseplate-500VDC

GENERAL SPECIFICATIONS

MTBF	1.8Mhrs Tb=40°C, 80%FL
Weight	2.29 oz (65g)
Dimensions	2.28" x 1.45" x 0.5"
	(57.91 x 36.83 x 12.7mm)

CONTROL SPECIFICATIONS

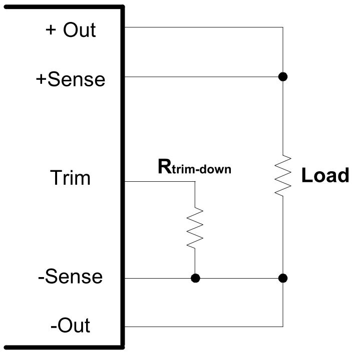
Logic ON/OFF Remote	
Positive Logic:	Off State Voltage: 0.8V max.
	On State Voltage: 2V min.
Negative Logic (optional):	Off State Voltage: 2V min.
	On State Voltage: 0.8V max.
Turn-On Time	40mS, Vo=90% of Vo, set
Trim Adjustment Range	90-110% See **TRIM CIRCUITS**
	Figs 1 & 2

NOTES

1. Bandwidth 5Hz to 20MHz and with filter 0.1uF MLCC
   Nominal Vin; Io=FL; Tb=25°C; Output Capacitor with 220uF*3.
2. Current Limit inception point Vo=90% of Vo, set.
3. 25%-50%-75% load, Δ Io/ Δ t=0.1A/uS; w/o Cap. 220uF*3 each
4. Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm
   Constant (Max. 5g) X, Y. Z 1 Hour each, at No Operation
5. Temperature measurement shall be taken from the baseplate (Tb).
   See Fig. 3 for location definition .
6. Tb=25°C, Nominal Vin, Full Load (FL)

TRIM CIRCUIT:

A. Trim down: The resistor for output voltage trim-down function could be calculated with the following formula:

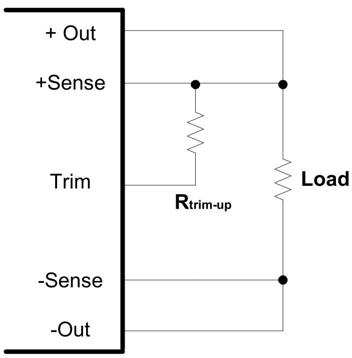


$$R_{trim-down} = \left(\frac{100\%}{\Delta\%} - 2 \right) (k\Omega)$$

Δ% : Output voltage change rate against nominal output voltage.

Fig. 1 The schematic for output voltage trim down.

B. Trim up: The resistor for output voltage trim-up function could be calculated with the following formula



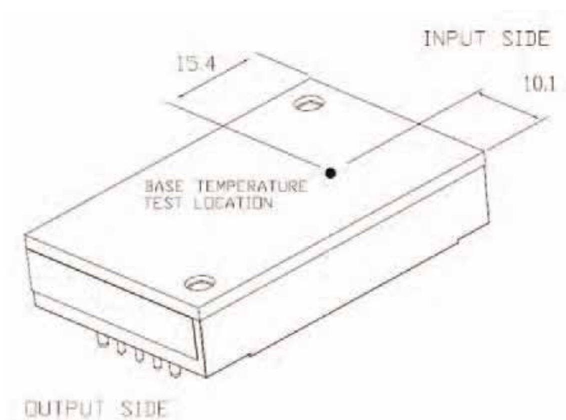
$$R_{trim-up} = \left[\frac{Vo(100\% + \Delta\%)}{1.225\Delta\%} - \frac{(100\% + 2\Delta\%)}{\Delta\%} \right] (k\Omega)$$

Vo: The nominal output voltage.

Δ% : Output voltage change rate against nominal output voltage.

Fig. 2 The schematic for output voltage trim up.

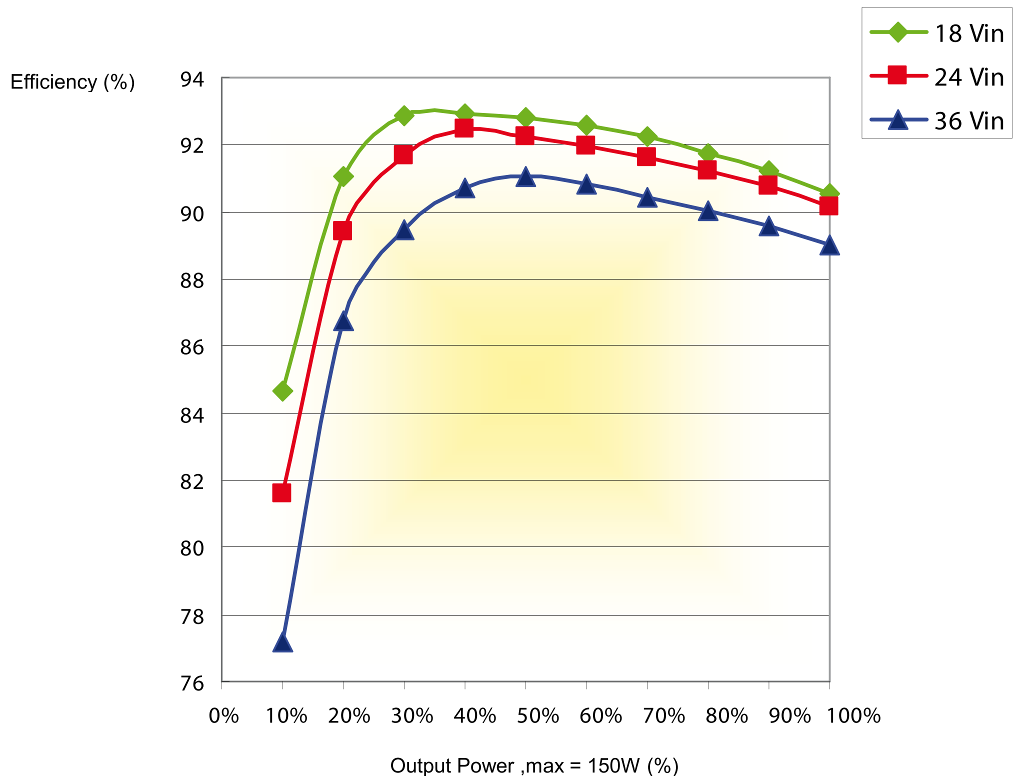
BASEPLATE MEASURE POINT:



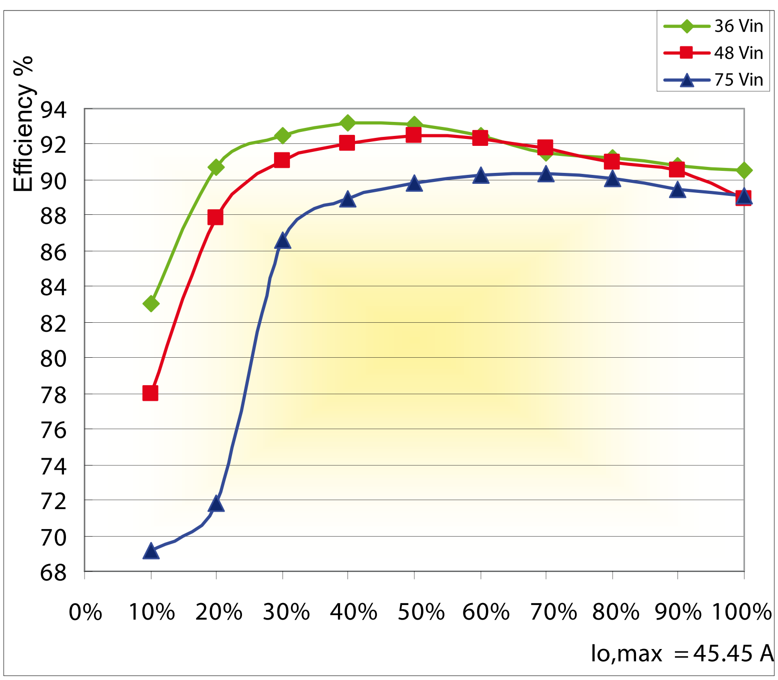
UNIT: mm

Fig. 3 Baseplate Temperature Measure Point.

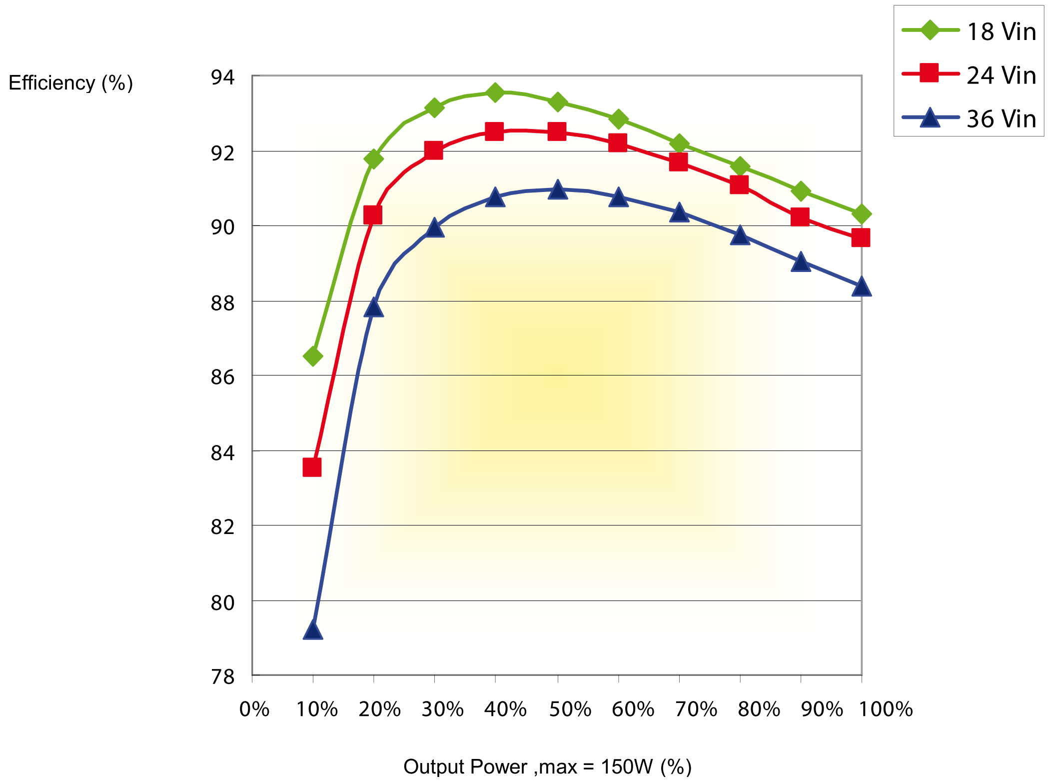
EFFICIENCY CURVE: 24VIN, 3.3VOUT



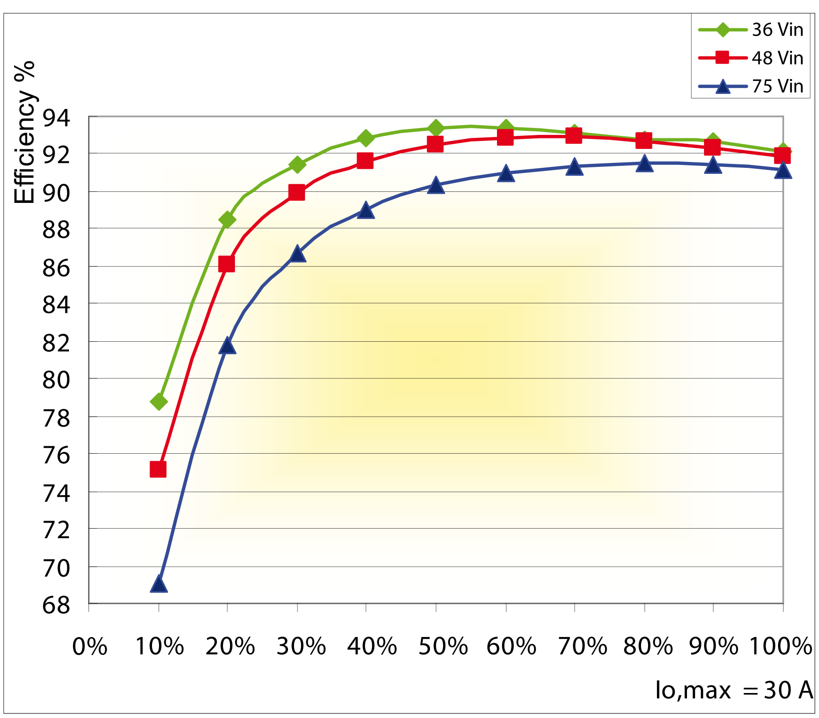
EFFICIENCY CURVE : 48VIN, 3.3VOUT



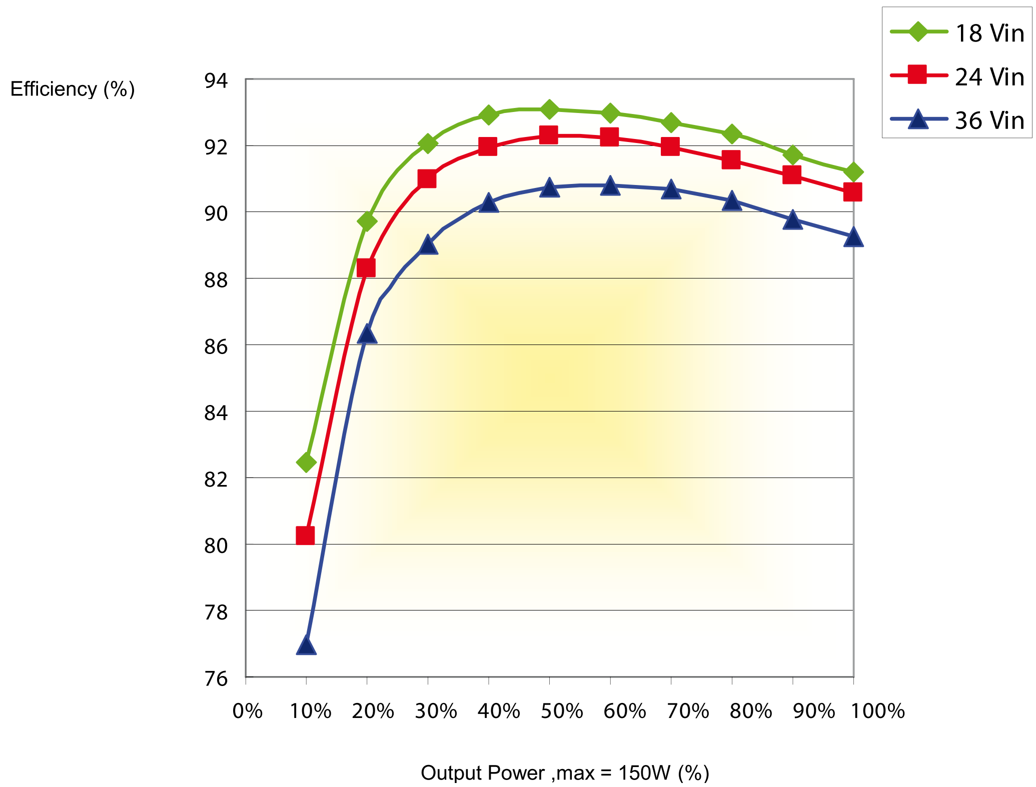
EFFICIENCY CURVE: 24VIN, 5.0VOUT



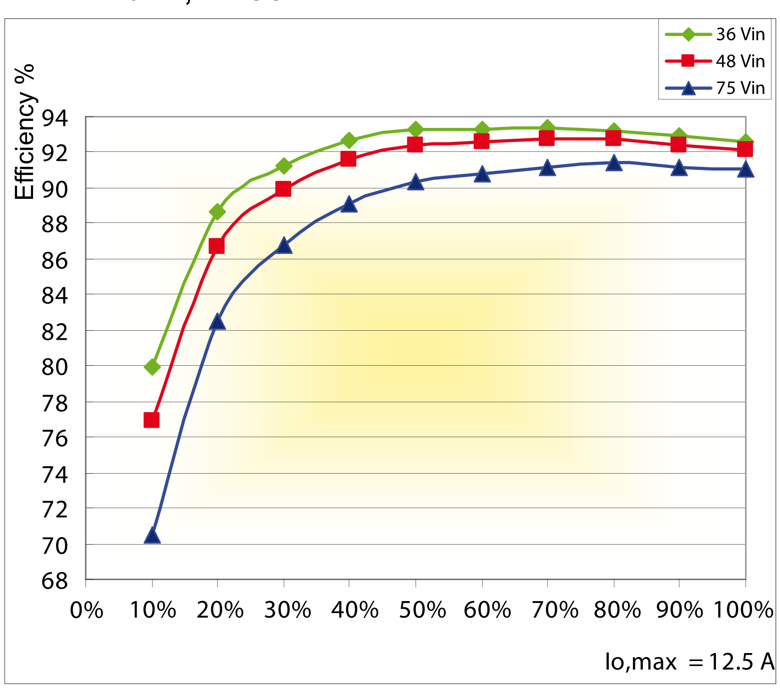
EFFICIENCY CURVE : 48VIN, 5.0VOUT



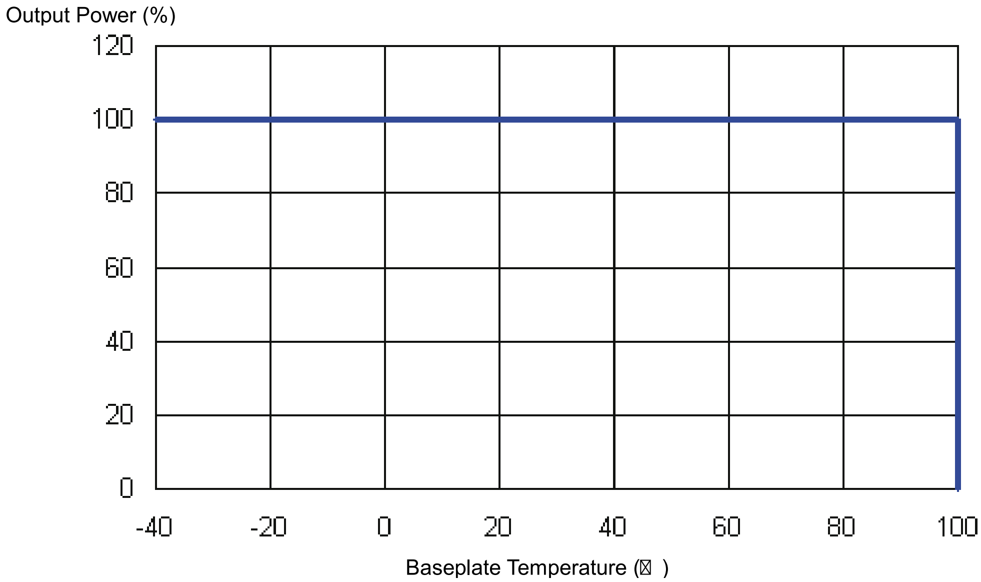
EFFICIENCY CURVE: 24VIN, 12VOUT



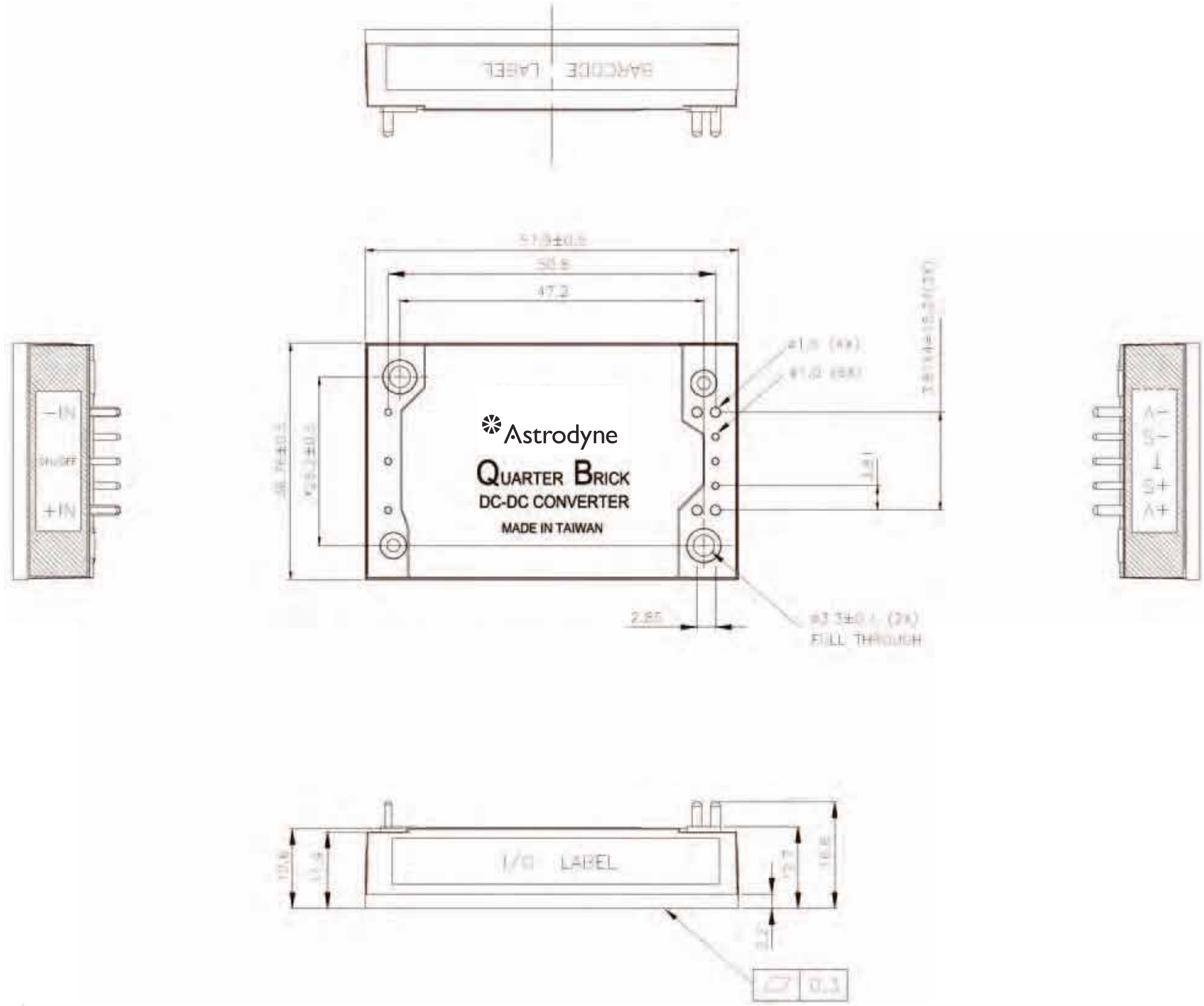
EFFICIENCY CURVE : 48VIN, 12VOUT



DERATING CURVE:



OUTLINE DRAWING:



OUTLINE PIN ASSIGNMENT:

Pin Number	Signal name: 3.3 & 5Vo	Signal name: 12Vo
1	Input (-)	Input (-)
2	On/Off Control	On/Off Control
3	Input (+)	Input (+)
4	Output (+)	No Pin
5	Output (+)	Output (+)
6	Sense (+)	Sense (+)
7	Trim	Trim
8	Sense (-)	Sense (-)
9	Output (-)	Output (-)
10	Output (-)	No Pin

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uV48-8-164

MicroVerter® -164 DC/DC Converter

48 VDC Input
288 Watts
3/4 Brick

The MicroVerter® uV48-8-164 DC/DC Converter Module combines high efficiency electrical power design and advanced thermal management techniques including insulated metal substrate technology and thermally conductive potting to produce a small, ruggedized DC/DC converter with reduced temperature rise and increased reliability. Operating over the entire 36-75VDC input range, the MicroVerter® uV48-8-164 is ideal for use in rugged and high reliability applications requiring baseplate cooled operation such as military, telecom, civil avionics and industrial control. This model is designed for 5/6 or 6/6 RoHS compliance and is designed to meet international safety approvals.

OPERATIONAL FEATURES

- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100ºC Baseplate Operation
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output Voltage
- Synchronizable from 330-400kHz (Optional)
- 2 Year Warranty

TYPICAL APPLICATIONS

- Network Infrastructure Equipment
- Telecommunication Equipment
- RF Power Amplifiers
- Medical Equipment
- Industrial Control

MODEL SELECTION (36-75VDC Input)

Model Number	Output Voltage	Output Current
uV48-8-164	8 (6.4-8.8)	36A

add **S** to part number to designate **SYNC** option.
add **LF** suffix for 6/6 RoHS compliance.
eg: uV48-8-**S**-164**LF**

5/6 or 6/6 RoHS Compliant

www.astrodyne.com

uV48-8-164

48 VDC Input / 288 Watts / 3/4 Brick

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ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Minimum	Maximum	Units	Conditions
Input Voltage (+In to -In)	-0.3	80	VDC	Continuous
Transient Input Voltage (+In to -In)	-0.3	100	VDC	100 msec. Max.
Parallel Pin Voltage (Parallel-On/Off Pin to -In)	-0.3	6.0	VDC	
Input-to-Output Voltage		2000	VDC	
Input-to-Case Votage		1500	VDC	
Output-to-Case Voltage		500	VDC	
Storage Temperature	-40	+110	ºC	
Operating Temperature	-40	+100	ºC	Baseplate
Soldering Temperature (Wave Solder)		260	ºC	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=48VDC, Vout=8VDC, Full Load, Tc=25ºC unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	36	48	75	VDC	
Maximum Input Current		9.8		ADC	Tc=25ºC, Vin=36V
			10.0	ADC	Tc=100ºC, Vin=36V
Input Ripple Rejection		60		dB	f=120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	7.92	8.00	8.08	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / ºC	Tc min to Tc max
Ripple (PARD)		80	160	mV p-p	Vin=48V, Tc=25ºC
			240	mV p-p	36V<Vin<75V, -40ºC<Tc<+100ºC
Rated Current			36	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% of Vout nominal
Short Circuit Current			170	% Rated	36V<Vin<75V, Rshort=15mOhm
Transient Response Deviation		240		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		100		µs	20-80% Rated Current, 0.5A/µs
Efficiency		86		%	Vin=48V, Iout=75% Rated
External Load Capacitance			750	µF	
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output Isolation	2000			VDC	Special Test Method Required
Input-to-Case Isolation	1500			VDC	
Output-to-Case Isolation	500			VDC	
Input-to-Output Capacitance		2250		pF	
Input-to-Output Resistance	10			M Ohm	500V

uV48-8-164

48 VDC Input / 288 Watts / 3/4 Brick

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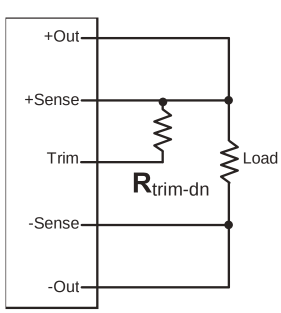
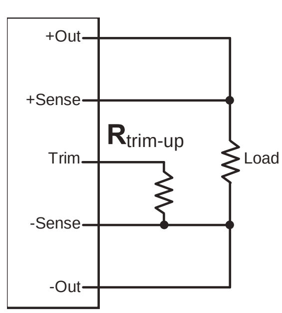
ELECTRICAL SPECIFICATIONS Continued

Control	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)		105		ºC	
Over Temperature Restart Temp (Tc)		85		ºC	
Start-up Voltage	33	34	35	VDC	
Input Under Voltage Lock Out	30	31	32	VDC	
Turn-on Time		4	8	msec	36V<Vin<75V, Tc=25ºC
			11	msec	36V<Vin<75V, -40ºC<Tc<+85ºC
Logic On/Off Enable Signal		Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal			0.6	VDC	I On/Off=1mA
Logic On/Off Turn-on Time		5	10	msec	
Trim Range	6.4		8.8	VDC	See Trim Formula and Diagrams
OVP Trip Point	9.2	9.6	10.4	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation			0.5	VDC	
Current Sharing (Parallel Operation)		5		%	Using Parallel Pin Connection or PDM
Switching Frequency		370		kHz	Standard Model
		300		kHz	-S Sync Option Model
Synchronization Frequency Range	330		440	kHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient		4.2		ºC/W	Free Air, No Heatsink, Tc=100ºC
Size, HxWxL		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{15.84K\Omega}{\Delta V}$$

$$R_{trim\text{-}down} = \frac{68.67-10.56\Delta V}{\Delta V}\ K\Omega$$

ΔV = | Desired Output Voltage Change (Volts) |
$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}
$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

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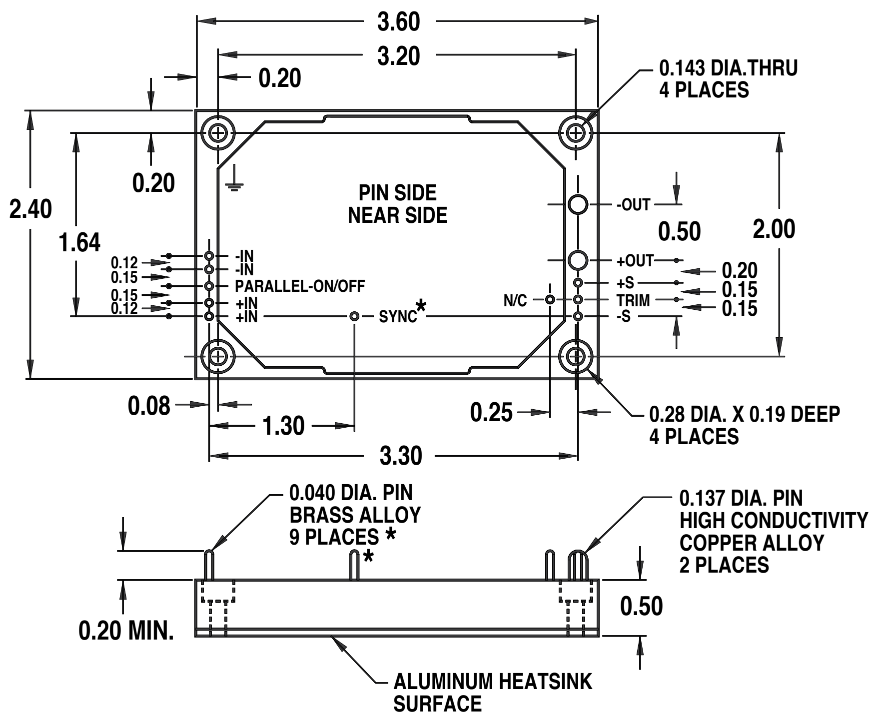
OUTLINE DRAWING Dimesions in Inches



NOTE:
Pin finish is gold over nickel, JESD97 2nd level interconnect category e4.
* 10 places when ordering sync option. Location of optional sync pin shown.

NOTES

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DATASHEET

uV48-12-164

MICROVERTER® -164 DC/DC Converter

48 VDC Input
300 Watts
3/4 Brick

The MICROVERTER® uV48-12-164 DC/DC Converter Module combines high efficiency electrical power design and advanced thermal management techniques including insulated metal substrate technology and thermally conductive potting to produce a small, ruggedized DC/DC converter with reduced temperature rise and increased reliability. Operating over the entire 36-75VDC input range, the MICROVERTER uV48-12-164 is ideal for use in rugged and high reliability applications requiring baseplate cooled operation such as military, telecom, civil avionics and industrial control. This model is designed for 5/6 RoHS compliance with international safety approvals and CE Mark compliance.

OPERATIONAL FEATURES

- 5/6 RoHS Compliant Design[2]
- Encapsulated & Environmentally Rugged Package
- Extremely Low Thermal Resistance
- -40 ~ 100ºC Baseplate Operation
- Constant Frequency Operation for Reduced Noise
- Remote On/Off, Parallel and Remote Sense Functions
- Auto-Recovery from OTP / OCP / OVP Circuits
- Trimable Output Voltage
- Synchronizable from 330-400kHz (Optional)
- 2 Year Warranty

TYPICAL APPLICATIONS

- Network Infrastructure Equipment
- Telecommunication Equipment
- RF Power Amplifiers
- Medical Equipment
- Industrial Control

MODEL SELECTION (36-75VDC Input)

Model Number	Output Voltage	Output Current
uV48-12-164	12 (10.8-13.2)	25A

add S to part number to designate SYNC option.
eg: uV48-12S-164

CE Mark (LVD)[1] UL / cUL 60950[1] 5/6 RoHS Compliant[2]

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Note 1: CE Mark (LVD) & UL / cUL 60950 pending
Note 2: 5/6 RoHS compliant for NIE (lead in solder) exemption

ABSOLUTE MAXIMUM RATINGS Exceeding absolute maximum ratings may cause permanent damage or reduce reliability

Parameter	Minimum	Maximum	Units	Conditions
Input Voltage (+ In to -In)	-0.3	80	VDC	Continuous
Transient Input Voltage (+In to -In	-0.3	100	VDC	100 msec. Max.
Parallel Pin Voltage (Parallel-On/Off Pin to -In)	-0.3	6.0	VDC	
Input-to-Output Voltage		2000	VDC	
Input-to-Case Votage		1500	VDC	
Output-to-Case Voltage		500	VDC	
Storage Temperature	-40	+ 110	°C	
Operating Temperature	-40	+ 100	°C	Baseplate
Soldering Temperature (Wave Solder)		260	°C	< 5 sec.

ELECTRICAL SPECIFICATIONS Electrical specifications apply for Vin=48VDC, Vout=12VDC, Full Load, Tc=25°C unless specified otherwise

Input	Minimum	Typical	Maximum	Units	Conditions
Input Voltage	36	48	75	VDC	
Maximum Input Current		9.8		ADC	Tc= 25°C, Vin= 36V
			10.0	ADC	Tc=100°C, Vin=36V
Input Ripple Rejection		60		dB	f= 120Hz
Output	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Voltage Set Point	11.88	12.01	12.12	VDC	
Load Regulation		0.05	0.2	%	0 to Full Load
Line Regulation		0.05	0.2	%	Vin min to Vin max
Voltage Drift w/Temperature			0.02	% / °C	Tc min to Tc max
Ripple (PARD)		120	240	mV p-p	Vin= 48V, Tc= 25°C
			360	mV p-p	36V<Vin<75V, -40°C<Tc<+100°C
Rated Current			25	A	
Overcurrent Inception Point	105	115	130	% Rated	Vout=95% of Vout nominal
Short Circuit Current			170	% Rated	36V<Vin<75V, Rshort=15mOhm
Transient Response Deviation		400		mV	20-80% Rated Current, 0.5A/µs
Transient Response Settling Time		250		µs	20-80% Rated Current, 0.5A/µs
Efficiency		88.5		%	Vin= 48V, Iout= 75% Rated
External Load Capacitance			750	µF	
Isolation	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Input-to-Output Isolation	2000			VDC	Special Test Method Required
Input-to-Case Isolation	1500			VDC	
Output-to-Case Isolation	500			VDC	
Input-to-Output Capacitance		2250		pF	
Input-to-Output Resistance	10			M Ohm	500V

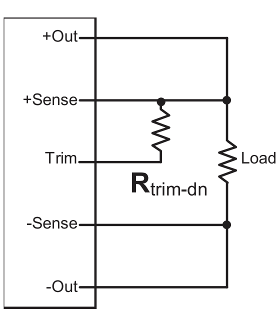
uV48-12-164

48 VDC Input / 300 Watts / 3/4 Brick

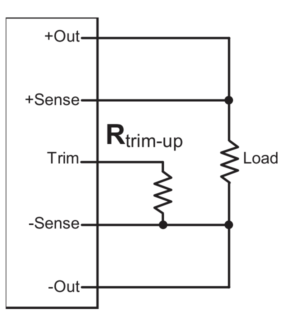
ELECTRICAL SPECIFICATIONS Continued

Control	Minimum	Typical	Maximum	Units	Conditions
Over Temperature Shutdown Temp (Tc)		105		ºC	
Over Temperature Restart Temp (Tc)		85		ºC	
Start-up Voltage	33	34	35	VDC	
Input Under Voltage Lock Out	30	31	32	VDC	
Turn-on Time		4	8	msec	36V< Vin< 75V, Tc= 25ºC
			11	msec	36V<Vin<75V, -40ºC<Tc<+85ºC
Logic On/Off Enable Signal		Open		VDC	Positive Logic, open collector enables. Do not pull up.
Logic On/Off Disable Signal			0.6	VDC	I On/Off= 1mA
Logic On/Off Turn-on Time		4	8	msec	
Trim Range	10.8		13.2	VDC	See Trim Formula and Diagrams
OVP Trip Point	14.7	14.9	15.8	VDC	Non-shutdown, Auto Recovery, Iout=50% Rated
Remote Sense Compensation			0.5	VDC	
Current Sharing (Parallel Operation)		5		%	Using Parallel Pin Connection or PDM
Switching Frequency		370		kHz	Standard Model
		300		kHz	-S Sync Option Model
Synchronization Frequency Range	330		440	kHz	Using Optional Sync Pin and External Sync Signal
Thermal / Mechanical Parameters	**Minimum**	**Typical**	**Maximum**	**Units**	**Conditions**
Thermal Resistance, Case to Ambient		4.2		ºC/W	Free Air, No Heatsink, Tc= 100ºC
Size, HxWxL		0.5 x 2.4 x 3.6 (12.7 x 61.0 x 91.4)		in (mm)	3/4 Brick, See Outline Drawing
Weight		5.7 (161)		oz. (g)	

TRIM



Trim Down



Trim Up

$$R_{trim\text{-}up} = \frac{29.01K\Omega}{\Delta V}$$

$$R_{trim\text{-}down} = \frac{203.0-19.34\Delta V}{\Delta V} \quad K\Omega$$

ΔV = | Desired Output Voltage Change (Volts) |

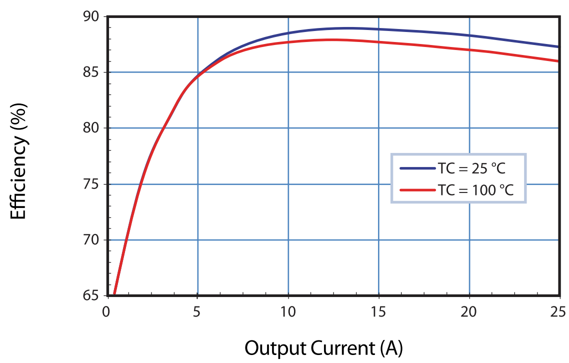
$R_{trim\text{-}up}$ = External Resistor Value to Increase V_{out}

$R_{trim\text{-}down}$ = External Resistor Value to Decrease V_{out}

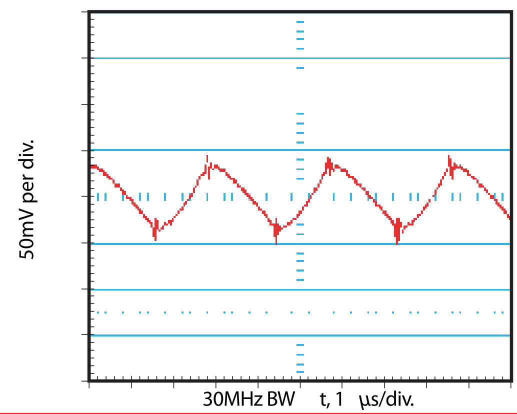
uV48-12-164

48 VDC Input / 300 Watts / 3/4 Brick

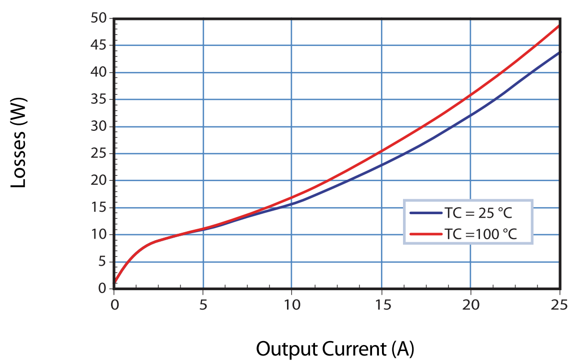
EFFICIENCY VS. LOAD, Vin=48V



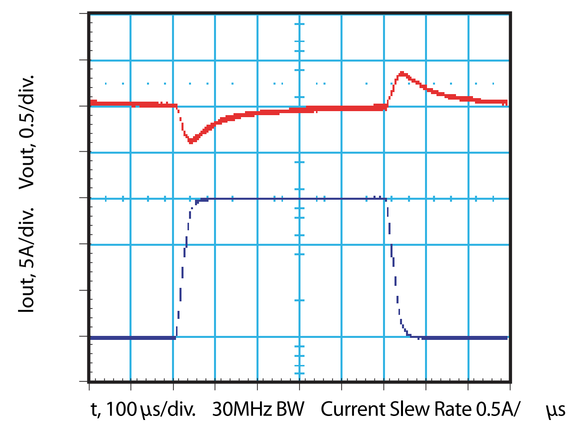
OUTPUT RIPPLE, Vin=48V, Iout=25A, Tc=25ºC



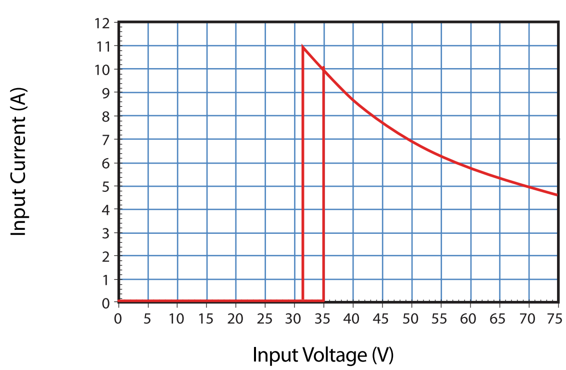
LOSSES VS. LOAD, Vin=48V



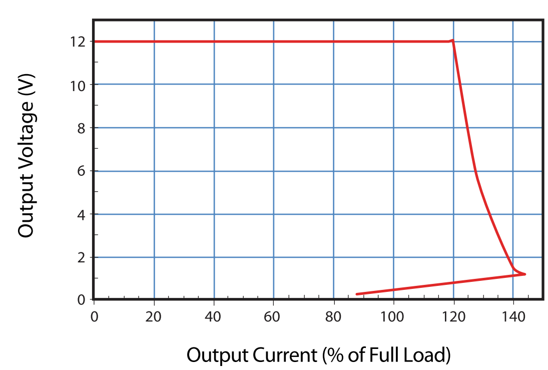
TRANSIENT RESPONSE, Vin=48V, Iout=5A-20A-5A, Tc=25ºC



INPUT CHARACTERISTIC, Iout=25A, TC=25ºC



OUTPUT CHARACTERISTIC, Vin=48V, TC=25ºC



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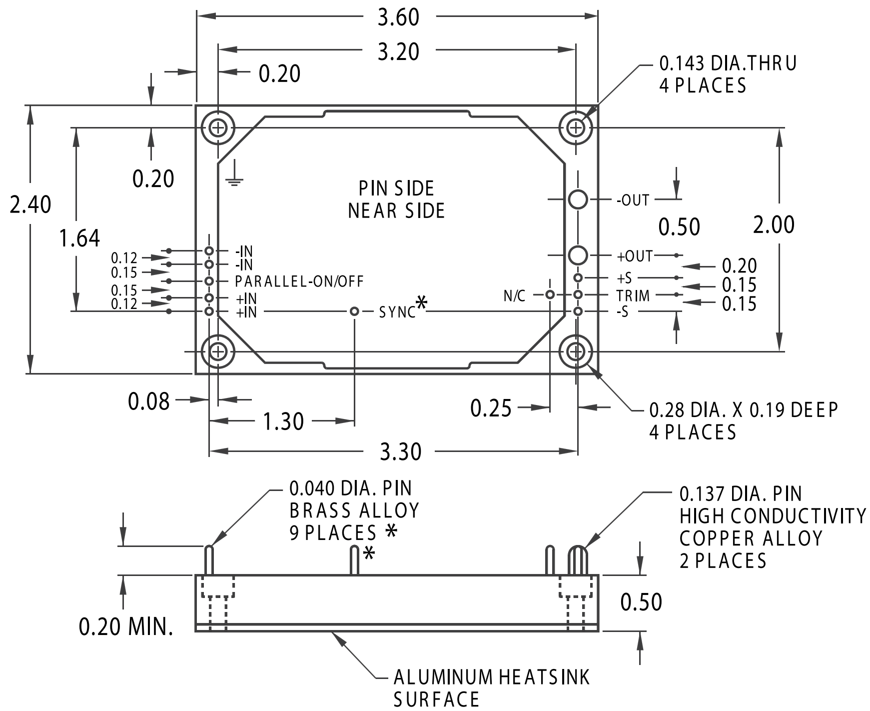
OUTLINE DRAWING Dimesions in Inches



NOTE:
Pin finish is gold over nickel, JESD97
2nd level interconnect category e4.
* 10 places when ordering sync option.
Location of optional sync pin shown.

NOTES

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