Wall Industries, Inc.

TECHNICAL DATASHEET
Rev. D

RA2405DUW8

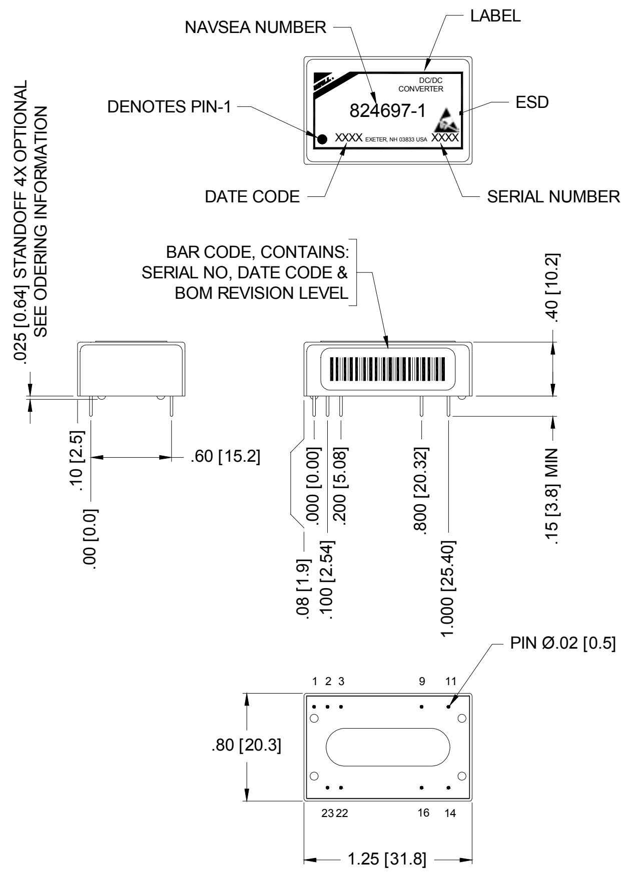
8 W DC-DC Converter
9-36 Vdc Input
±5 Vdc Output at 800 mA Each
DIP Package
High Reliability COTS Converter

Features:

- **Over 81% Efficient at Full Load**
- **Wide Input Range**
- **Fast Transient Response**
- **Low Output Ripple**
- **Fixed Switching Frequency**
- **Output Over Current Protection**
- **Output Short Circuit Protection**
- **1000 Vdc Isolation**
- **ISO9001 Compliant**
- **IPC-A-610 Compliant**
- **J-STD-001 Compliant**
- **Conformal Coat IAW IPC-CC-830, Type UR**
- **GEIA-STD-0005-2, Level 2B Tin Whisker Compliant**
- **100% Burn In**
- **Manufactured in the United States**

Technical Specifications	Model No. RA2405DUW8				
Unless otherwise noted, all specifications are based over the entire rated ambient temperature as described in Graph 2.					
SPECIFICATION	**Related condition**	**Min**	**Nom**	**Max**	**Unit**
Switching Frequency		273	307	338	kHz
INPUT (V_{in})					
Operating Voltage Range		9	24	36	Vdc
UVLO Turn On at		8.17	8.59	9.02	Vdc
UVLO Turn Off at		7.70	7.99	8.29	Vdc
UVLO Hysterisis		0.47	0.6	0.73	Vdc
Maximum Input Current *(Graph 3)*	Low Line	-	1100	1160	mA
No Load Input Current *(Graph 5)*	No Load	-	18	30	mA
Reflected Ripple Current *(Photos 1 & 2)*	With a 1 uF ceramic across the input	-	15	40	mA
Input Surge Voltage	100 mS	-	-	50	Vdc
Input Capacitance	At 25°C	4.11	5.14	6.17	uF
EFFICIENCY *(Graph 1)*	$= \frac{P_o(\text{Full Load})}{P_{in}(\text{Full Load})}\Big\vert_{V_{in} = \text{Nominal Line}}$	80	82	-	%
OUTPUT (V_o)					
V_{o1} & V_{o2} Voltage Set Point	Measured at full load and nominal V_{in} at 25 °C – see Temperature Drift for Set Point at other temperatures	4.925 -1.50	5.000	5.075 +1.50	Vdc %
V_{o1} & V_{o2} Load Regulation *(Graph 6)*	$= \frac{V_{ox}(\text{Min. Load}) - V_{ox}(\text{Full Load})}{V_{ox}(\text{Min. Load})}\Big\vert_{I_{o1} = I_{o2},\ V_{in} = \text{Nominal Line}}$	-	0.15	1.0	%
V_{o1} & V_{o2} Line Regulation *(Graph 7)*	$= \frac{V_{ox}(\text{Low Line}) - V_{ox}(\text{High Line})}{V_{ox}(\text{Low Line})}\Big\vert_{I_{o1} = 50\%\ \text{Load},\ I_{o2} = 50\%\ \text{Load}}$	-	0.05	0.5	%
V_{o1} & V_{o2} Cross Regulation *(Graph 9)*	$= \frac{V_{ox}(50\%\ \text{Load}) - V_{ox}(25\ \text{or}\ 75\%\ \text{Load})}{V_{ox}(50\%\ \text{Load})}\Big\vert_{I_{oy} = 50\%\ \text{Load},\ V_{in} = \text{Nominal Line}}$	-	1.0	2.0	%
Temperature Drift *(Graph 8)*	$= \frac{V_{ox}(25°C) - V_{ox}(-40°C\ \text{or} + 85°C)}{V_{ox}(25°C)}\Big\vert_{I_{o1}\ \&\ I_{o2} = 50\%\ \text{Load},\ V_{in} = \text{Nominal Line}}$	-	0.01	0.02	% / °C
V_{o1} & V_{o2} Ripple and Noise *(Photo 9)*	Measured at full load and nominal line with a 1 uF ceramic across the output & 20 MHz BW	-	50	100	mV_{pk-pk}
V_{o1} & V_{o2} Current		0.04	-	0.80	A
Current Limit	Power Limited – Total Output Current	2.0	3.0	4.0	A
Over Voltage Limit	V_{o1} & V_{o2}	±6.8	±7.4	±8.0	Vdc
DYNAMIC RESPONSE					
Load step Δ V *(Photos 3 & 4)*	25% to 75% Io, di/dt=0.15A/uS, C_{out}=1uF	-	275	400	mV
Recovery Time *(Photos 3 & 4)*	Recovery to within 1% Vout (nom), C_{out}=1uF	-	200	300	µs
Turn On Delay *(Photo 5)*	From V_{in}(min) to V_{out} (90%), no external capacitance	-	11	20	ms
Turn On Overshoot *(Photos 5 & 6)*	Full Load Resistive	-	0	0	%
Hold Up Time *(Photo 8)*	From Vin (min) to $V_{ULVO\_Turn\_Off}$	0	-	-	mS
REMOTE ON/OFF	**Active High**				
Remote ON – Active High	Min High to Enable	2.0	-	6.0	Vdc
Remote OFF – Active High	Max Low to Disable	-	-	0.8	Vdc
Remote ON/OFF pin Floating – Active High	Over Operating Voltage Range	1.2	-	5.5	Vdc
$I_{ON/OFF}$ Sink to pull low – Active High	V_{Enable}=0V, Vin=36V	-	1.2	1.5	mA
Turn On Delay – *(Photo 7)*	Enable (max Low) to Vout (min)	-	11	12	ms
Turn Off Delay – *(Photo 8)*	Enable (0V) to Vout (min)	-	3	6	mS
Input Current During Remote Off – Graph 6	At Nominal Input Voltage	-	7.5	10	mA
Maximum Input Voltage	At Enable pin	-	-	25	Vdc
ISOLATION					
Input-Output	1 minute	1000	-	-	Vdc
Input/Output-Chassis	1 minute	1000	-	-	Vdc
Isolation Resistance		20	-	-	GΩ
Isolation Capacitance		-	2350	3000	pF
THERMAL					
Ambient Operating Temperature *(Graph 2)*	Max. Ambient limited by Derating Curves (Graph 2)	-40	25	Graph 2	°C
Storage Temperature		-55	-	125	°C
MTBF	MIL-HDBK-217F Notice 2; T_{amb}=75°C		369,0000		hours
MECHANICAL			**See Figure 1**		
Weight		17	19	21	g

Figure 1: Mechanical Dimensions



NOTES:

1. Pin to Pin Tolerance: ± 0.01 (±0.3)
2. Pin Diameter Tolerance: ±0.005 (±0.13)
3. Unless otherwise specified all dimensions are in inches [XX] are in millimeters.
4. Applied Tolerances: Angles ±1°, .XX = ±0.02 [0.5] .XXX = ± 0.010 [0.25]
5. Do not scale drawing. Interpret dimension and tolerance per ASME Y14.5M – 1994
6. Third Angle Projection
7. Pin Material: Brass alloy "360, ½ Hard" per ASTM B16-85; chemical composition: 61.5% Cu, 35.4% Zn, 3.1% Pb
8. Pin Finish: 10u Gold over Nickel. Meets the solderability requirements of MIL-STD-202, Method 208.
9. PCB Cleaning: Devices shall be capable of exposure to the following PCB assembly cleaning processes: Aquanox XJN+ an aqueous cleaner chemistry made by Kyzen Corp. This solution operates at a concentration of 25% XJN and 75% deionized water sprayed onto the device at 25-40 PSI. This cleaning process includes the following steps:
    a. Pre-wash and wash at 150°F. Dwell time 3-4 minutes.
    b. Isolation water rinse at 140°F
    c. Deionized water rinse at 140°F
    d. Final deionized water rinse
    e. Blower dry
    f. 1 hour CCA bake at 125 Deg F prior to CCA conformal coat.
10. Unit is not hermetically sealed
11. Pin Table:

Pin #	Description	Pin Ø
1	Enable	0.020 (0.51)
2	$-V_{in}$	0.020 (0.51)
3	$-V_{in}$	0.020 (0.51)
9	Common	0.020 (0.51)
11	$-V_{out}$ (V_{o2})	0.020 (0.51)
14	$+V_{out}$ (V_{o1})	0.020 (0.51)
16	Common	0.020 (0.51)
22	$+V_{in}$	0.020 (0.51)
23	$+V_{in}$	0.020 (0.51)

DESIGN CONSIDERATIONS

Under Voltage Lock Out (UVLO)
The converter output is disabled until the input voltage exceeds the UVLO turn-on limit. The converter will remain ON until the input voltage falls below the UVLO turn-off limit.

Over Current Protection
The converter is protected from short circuit and over current conditions. Upon sensing an over current, the output will begin to drop (or 'foldback') limiting the output power. Further increasing the output current will cause the converter to shut off and then restart (or 'hiccup') until the over current condition is removed. Shorting the output will cause the converter to immediately enter the 'hiccup'mode.

Over Temperature Protection
The converter is NOT protected from over temperature conditions. Exceeding the rated case temperature of 100°C may cause permanent damage to the unit.

Input Filter
No additional input capacitor is needed for the power supply to operate. However, to reduce input ripple and high frequency noise, it is highly recommended that a minimum 1 μF/50 V ceramic capacitor be added across the input pins.

Output Filter
No additional output capacitor is needed for the power supply to operate. However, to reduce high frequency noise, it is highly recommended that a minimum 1μF/10V ceramic capacitor be added across the output pins.

Remote ON/OFF
This converter has the ability to be remotely turned ON or OFF. The RA series is primary-side referenced Active-High. Active-High means that a logic high between the ENABLE pin and –Vin will turn ON the supply. With Active-High, if the ENABLE pin is left floating, the supply will still be enabled

Fusing
For applications that are required to meet UL and/or CSA safety regulations, the input to the converter shall be current limited or supplied through a 3 A fuse. This unit is designed to meet these regulations, but is not certified.

Burn-In
Units are 100% burned in at full load, nominal line and 50°C ambient for 24 hours.

Final Electrical Test
See Appendix I for description of Final Electrical Test. All units tested 100% at 25°C.

Qualification Testing
40 samples, No Failures Allowed, 40/0 (Devices shall be exposed to PCB cleaning process prior to testing)

Subgroup 1 - 1000 hour life test per MIL-STD-883, Method 1015:

1. 10 samples, No Failures Allowed, 10/0
2. Final Electrical Test performed at maximum ambient and full load per Graph 2 with no external air
3. Final Electrical Test performed at 168, 250, 500 and 1000 hours

Subgroup 2 - Accelerated Non-Operating Humidity and Thermal/Mechanical Fatigue:

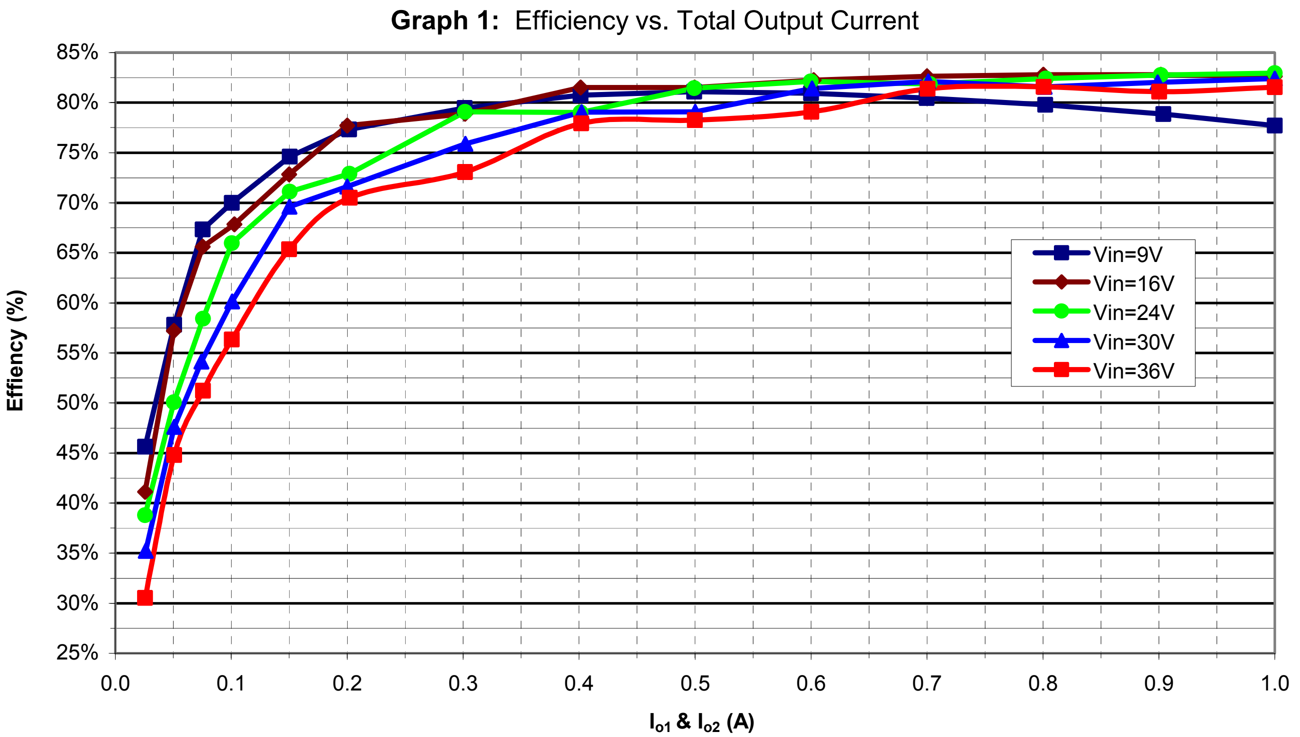
1. 10 samples, No Failures Allowed, 10/0
2. 500 hrs at 85°C at 85% Relative Humidity, Unbiased
3. 200 temperature cycles (T/C), -46°C to +85°C @ 5°C/minute minimum, 45 minute dwell
4. Final Electrical Test at 25°C
5. 500 hrs at 85°C at 85% Relative Humidity, Unbiased
6. 200 temperature cycles (T/C), -46°C to +85°C @ 5°C/minute minimum, 45 minute dwell
7. Final Electrical Test at 25°C

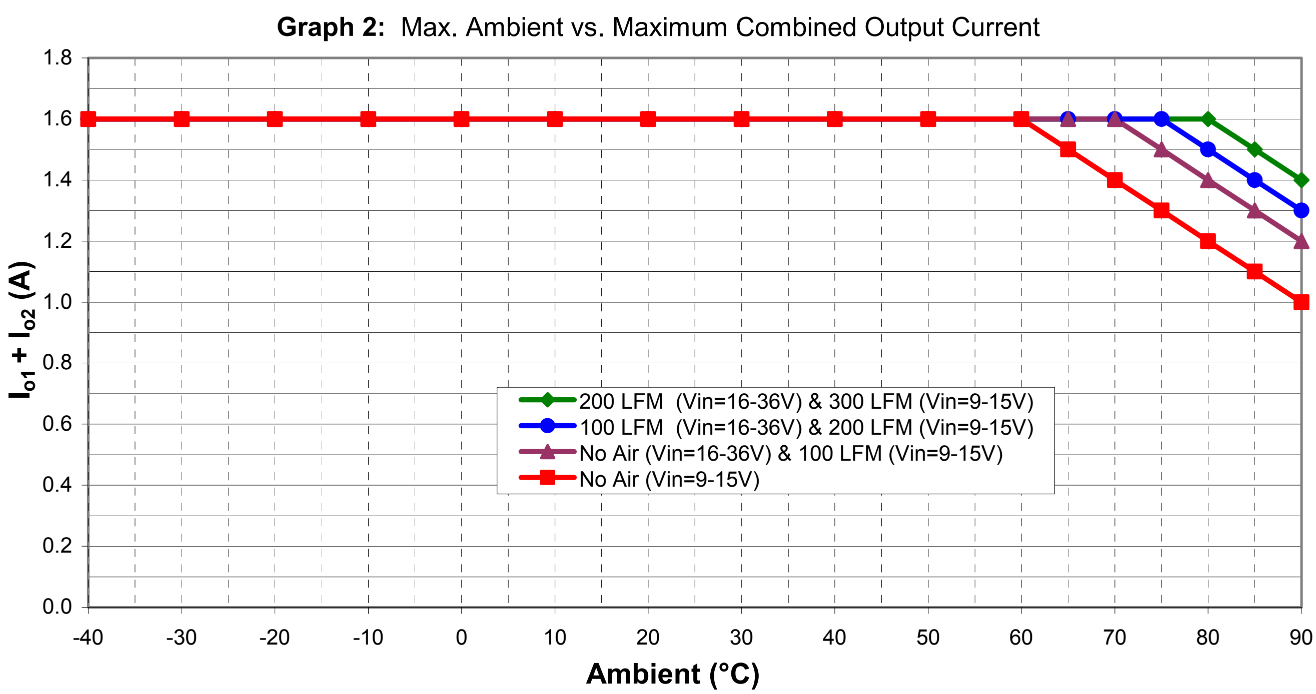
Subgroup 3 - Snap Start from Low Operating Temp:

1. 10 samples, No Failures Allowed, 10/0
2. Cold soak at -40°C until device reaches thermal equilibrium
3. Power up under full load with worse case input transient waveform applied (as specified on datasheet)
4. Total cycles: 500 (definition of 1 cycle: -40°C soak, power up, re-soak -40°C)
5. Final Electrical Test at 25°C

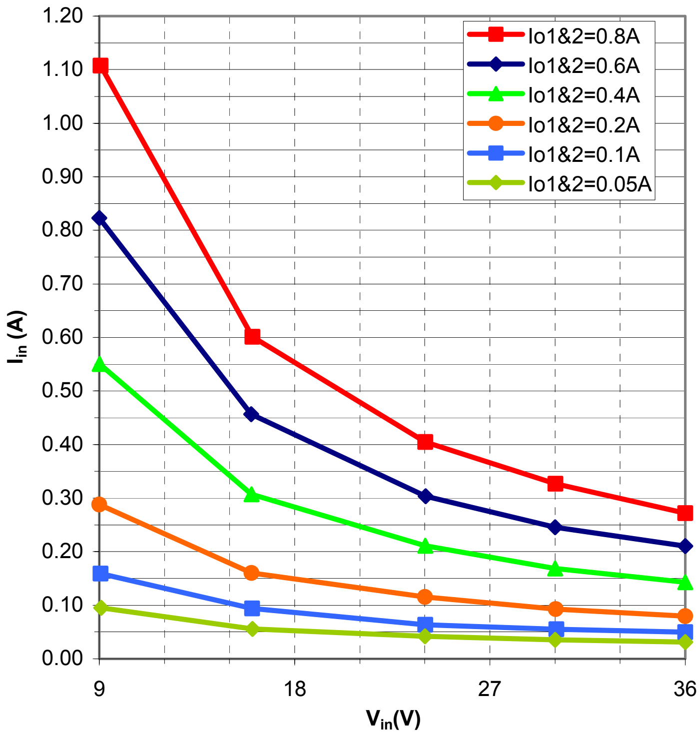
Subgroup 4 - Non-Operating Vibration and Shock:

1. 10 samples, No Failures Allowed, 10/0
2. Non-operating Mechanical Shock: Method 2002, MIL-STD-883, Condition B, 1500g, 0.5 ms pulse
3. Non-operating Random Vibration: Method 2026, MIL-STD-883, Condition K, 44.8 grms
4. Final Electrical Test at 25°C

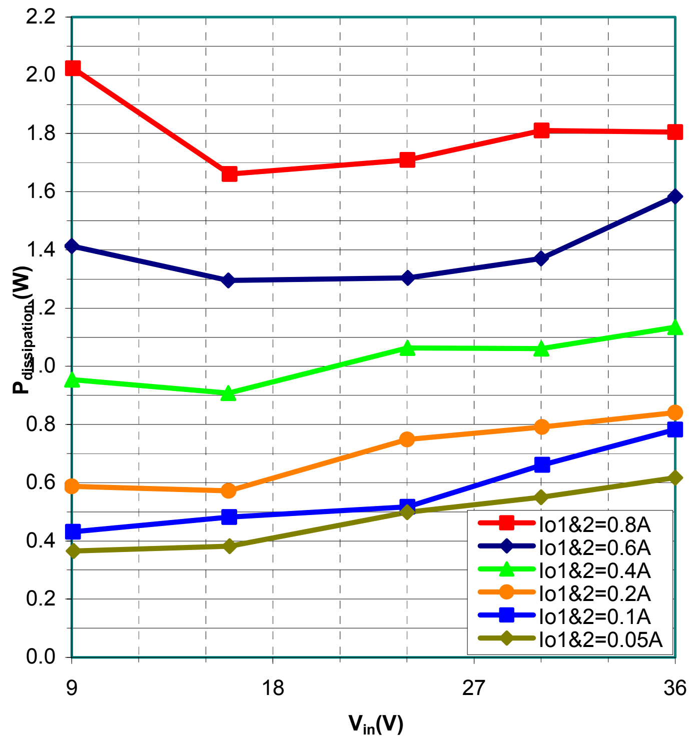

Graph 1: Efficiency vs. Total Output Current
Effiency (%)
85%
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
I_{o1} & I_{o2} (A)
Vin=9V
Vin=16V
Vin=24V
Vin=30V
Vin=36V


Graph 2: Max. Ambient vs. Maximum Combined Output Current
I_{o1} + I_{o2} (A)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-40
-30
-20
-10
0
10
20
30
40
50
60
70
80
90
Ambient (°C)
200 LFM (Vin=16-36V) & 300 LFM (Vin=9-15V)
100 LFM (Vin=16-36V) & 200 LFM (Vin=9-15V)
No Air (Vin=16-36V) & 100 LFM (Vin=9-15V)
No Air (Vin=9-15V)

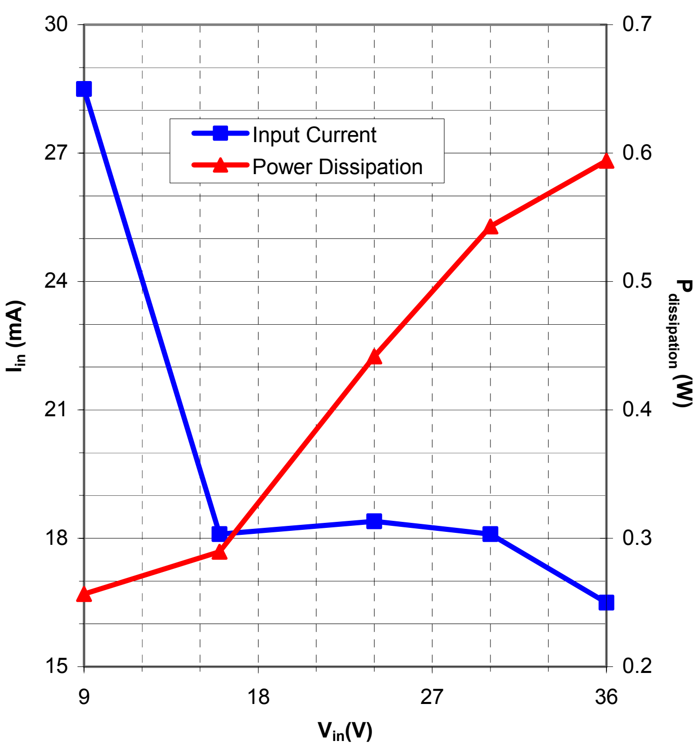
Graph 3: Input Current vs. Input Voltage



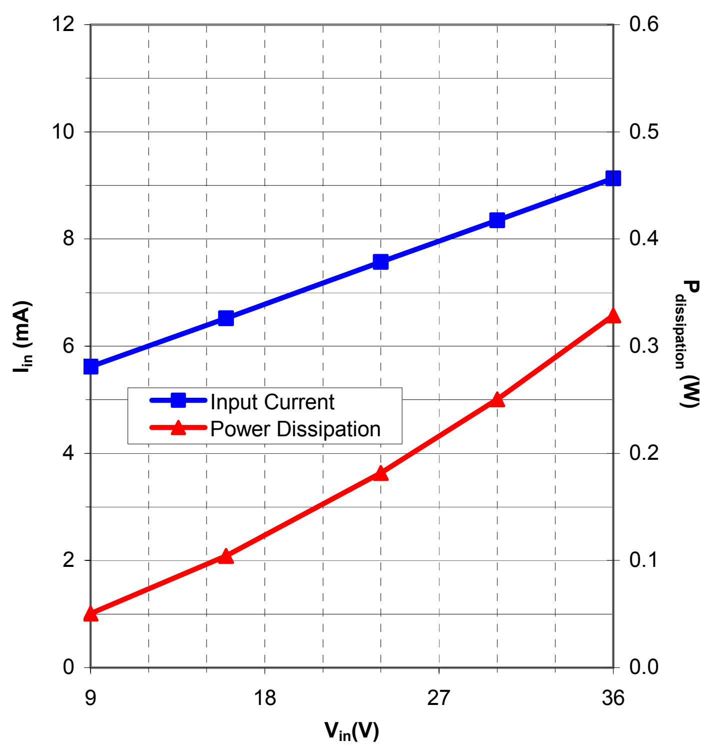
Graph 4: Power Dissipation vs. Input Voltage



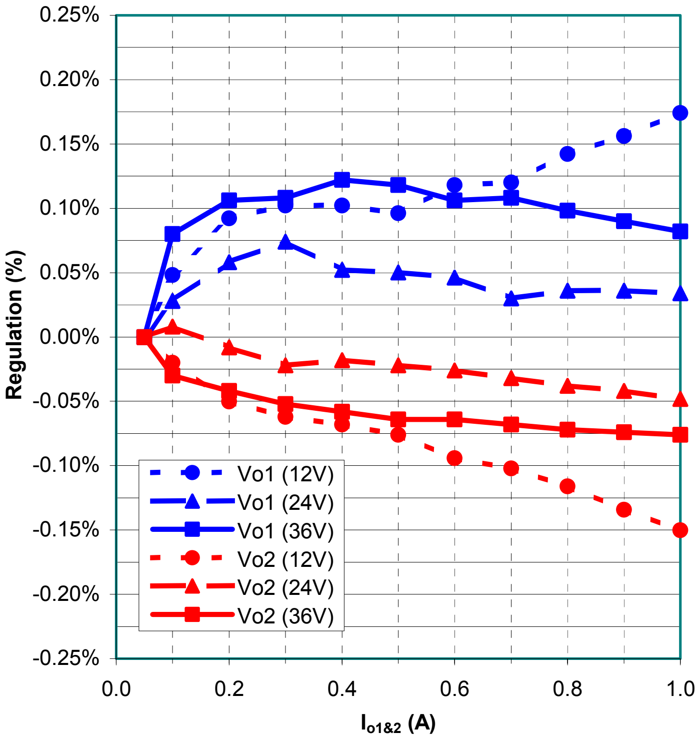
Graph 5: No Load Input Current and Power Dissipation vs. Input Voltage



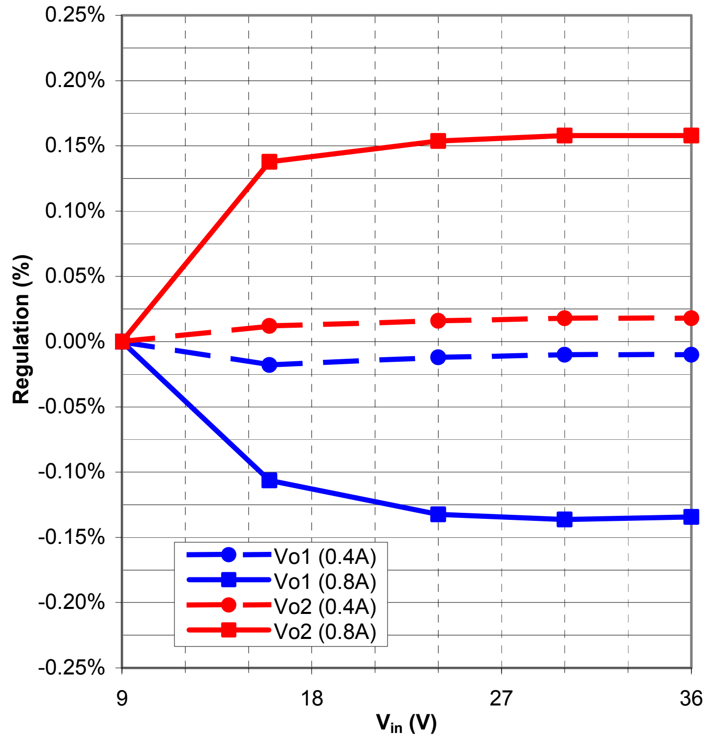
Graph 6: 'Remote Off' Input Current and Power Dissipation vs. Input Voltage



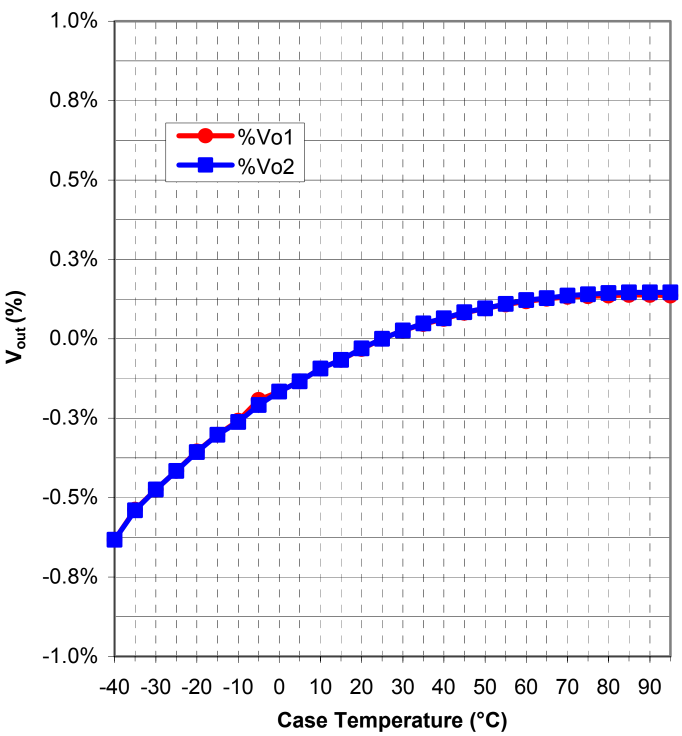
Graph 6: Load Regulation



Graph 7: Line Regulation



Graph 8: Output Temperature Drift



Graph 9: Cross Regulation V_{o1} and V_{o2} vs. I_{o1} or I_{o2} while I_{o2} or I_{o1} = 0.4 A; V_{in} = 24 Vdc

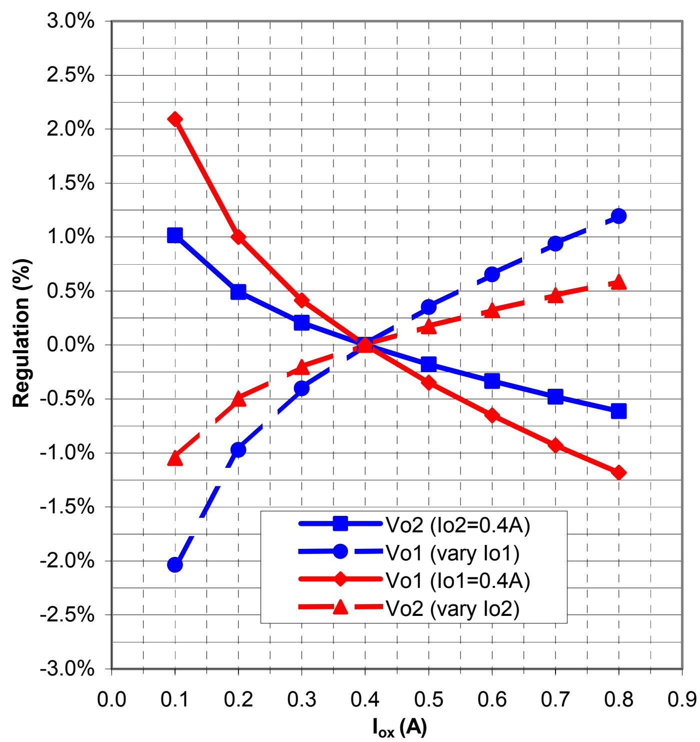


Photo 1: Input Ripple Voltage and Current
Vin = 24 V, I_{o1} & I_{o2} = 0.8 A

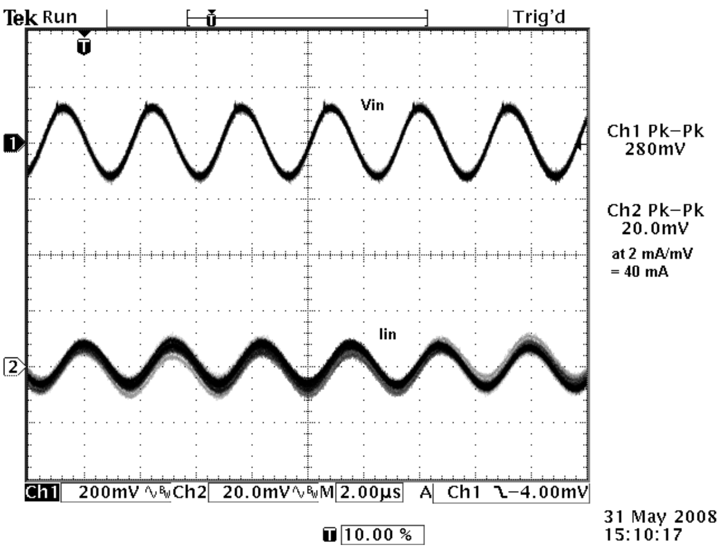


Photo 2: Input Ripple Voltage and Current
Vin = 24 V, I_{o1} & I_{o2} = 0.8 A
With a 1 µF Ceramic across the Input

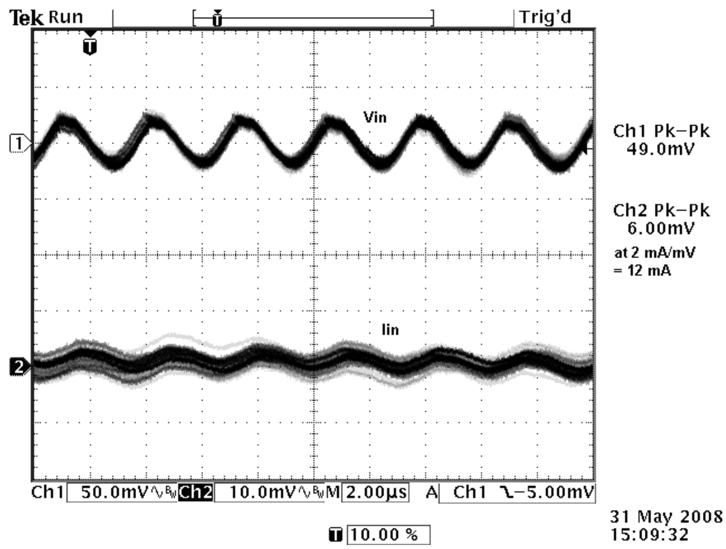


Photo 3: V_{o1} (+V_{out}) Transient Response – 0.15A/µs
Vin = 24 Vdc, I_{o1} = 0.2 to 0.6 A (25% to 75%); I_{o2} = 0.4 A
With 1 uF Ceramic across the Output

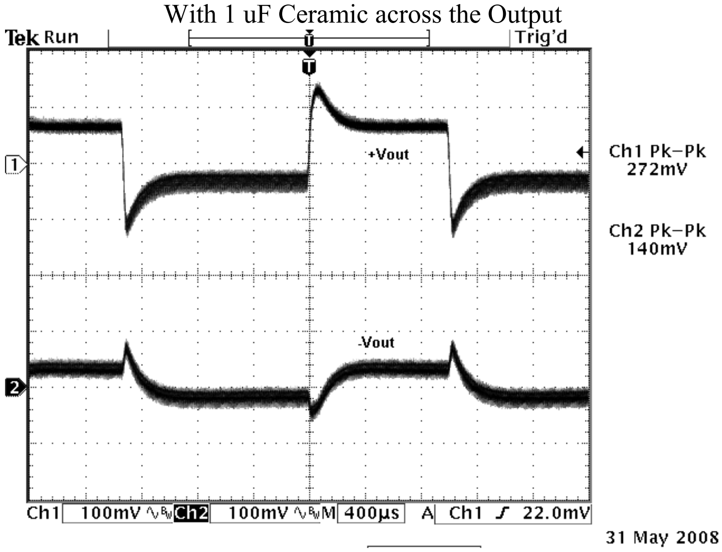


Photo 4: V_{o2} (-V_{out}) Transient Response – 0.15A/µs
Vin = 24 Vdc, I_{o2} = 0.2 to 0.6 A (25% to 75%); I_{o1} = 0.4 A
With 1 uF Ceramic across the Output

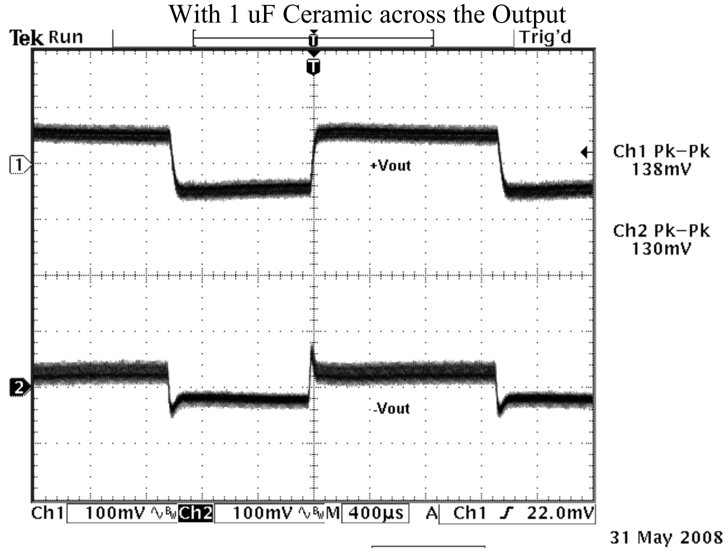


Photo 5: Normal Turn On at Full Load

Vin = 24 Vdc; I_{o1} & I_{o2} = 0.8 A

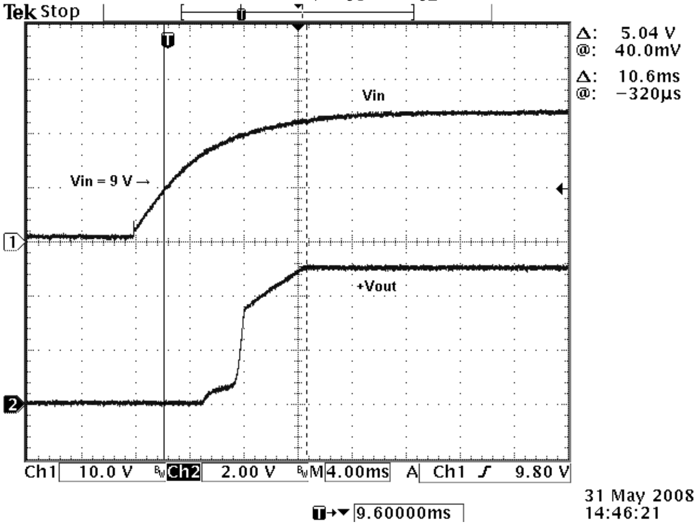


Photo 6: Normal Turn On at Full Load

Vin = 24 Vdc; I_{o1} & I_{o2} = 0.8 A

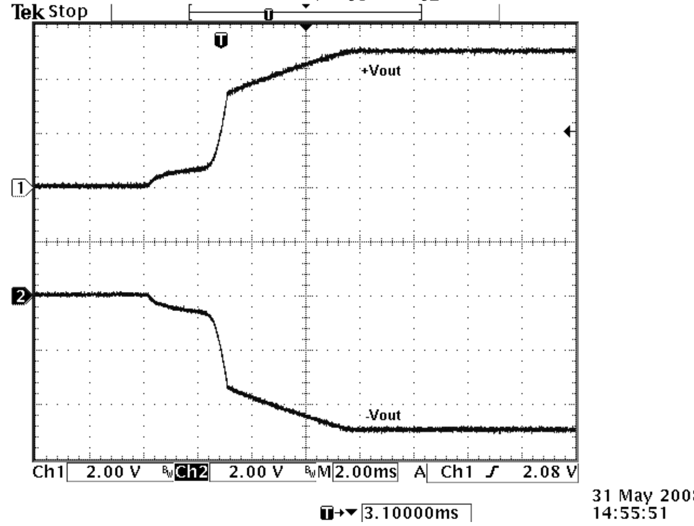


Photo 7: Turn On by Enable

Vin = 24 Vdc; I_{o1} & I_{o2} = 0.8 A

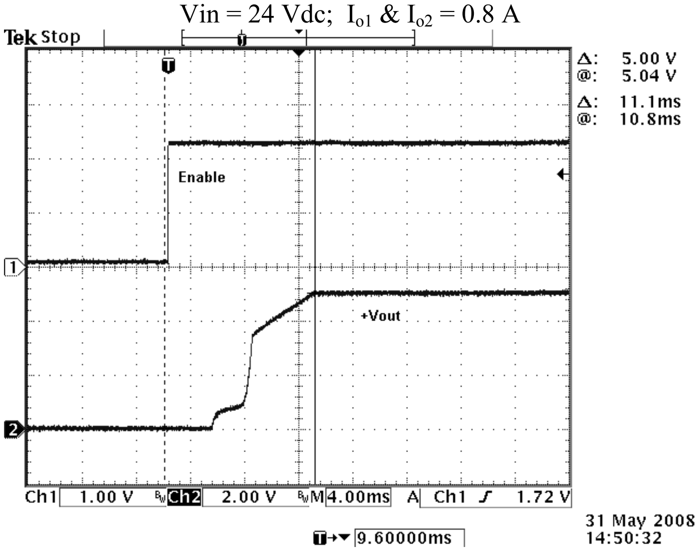


Photo 8: Turn Off by Enable

Vin = 24 Vdc; I_{o1} & I_{o2} = 0.8 A

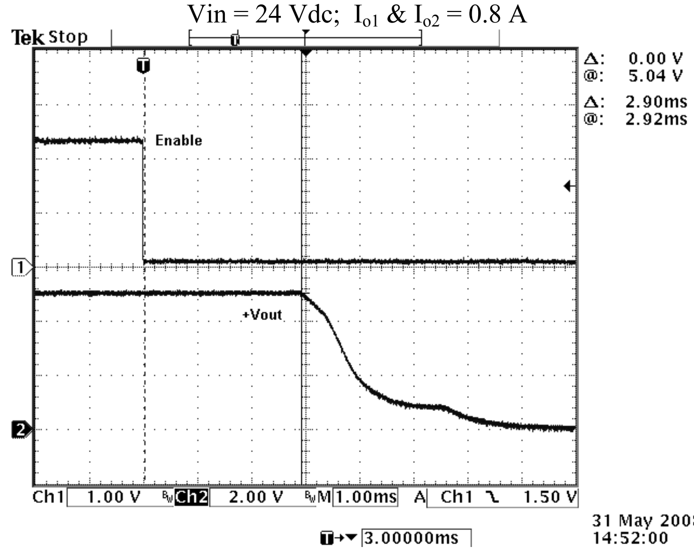


Photo 9: Output Ripple and Noise (20 MHz BW)

Vin = 24V, I_{o1} & I_{o2} = 0.8 A

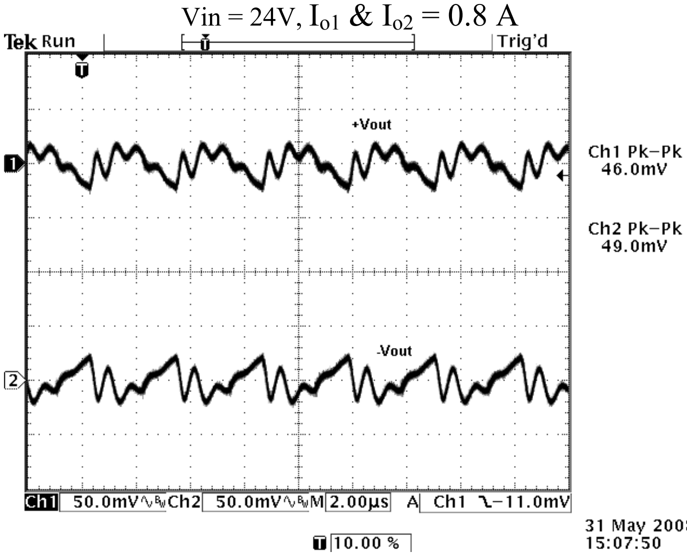
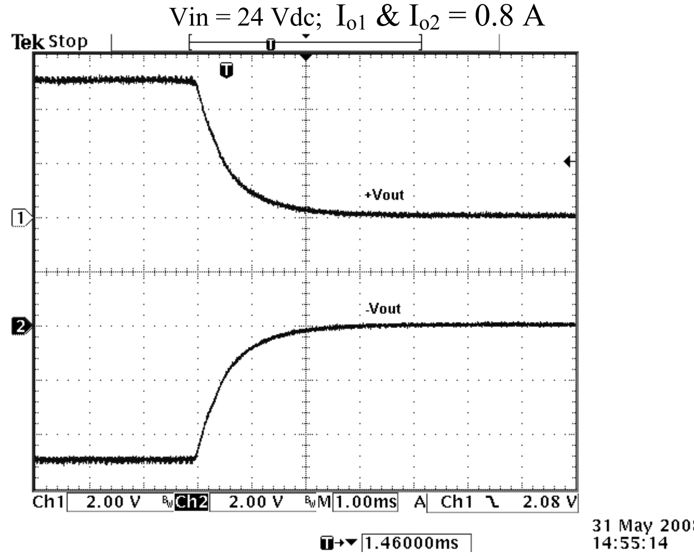


Photo 10: Normal Turn Off at Full Load

Vin = 24 Vdc; I_{o1} & I_{o2} = 0.8 A



PART ORDERING:

RA2405DUW8
RA2805DUW8/ES (with Electrical Screening)
RA2405DUW8/SO (with Standoffs)
RA2405DUW8/ES/SO (with Electrical Screening and Standoffs)

Electrical Screening Option:

1. Internal Visual: IPC-A-610
2. Temperature cycling: MIL-STD-883, Method 1010, Condition B, -55 to +125°C, 10 cycles
3. Burn-In: MIL-STD-883, Method 1015, 96 hours, I_{out}=1.0 A, Ambient as specified in Graph 2 for specified input voltage range and no external air
4. Final Electrical: 100% at 25°C, See Appendix I
5. External Inspection: MIL-STD-883, Method 2009

Company Information:

Wall Industries, Inc. has created custom and modified units for over 40 years. Our in-house research and development engineers will provide a solution that exceeds your performance requirements on-time and on budget. Our ISO9001-2000 certification is just one example of our commitment to producing a high quality, well documented product for our customers.

Our past projects demonstrate our commitment to you, our customer. Wall Industries, Inc. has a reputation for working closely with its customers to ensure each solution meets or exceeds form, fit and function requirements. We will continue to provide ongoing support for your project above and beyond the design and production phases. Give us a call today to discuss your future projects.

Contact **Wall Industries** for further information:

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Exeter, NH 03833

Appendix I

RA2405DUW8 ATE FINAL ELECTRICAL TEST DESCRIPTION
Rev. – A 3/21/08

Sequence #1 - Set State
- Set Vin = 24 Vdc
- Set Iout1 & Iout2 = 0.8 A

Sequence #2 - Output voltage accuracy
- Under the previously set conditions, measure the output voltages.
- V min = 4.95 Vdc
- V max = 5.05 Vdc

Sequence #3 - Efficiency
- Under the previously set conditions, measure the efficiency.
- Min E = 80%
- Max E = 99%

Sequence #4 - Set State
- Set Vin = 24 Vdc
- Set Iout1 & Iout2 = 100 mA

Sequence #5 - Efficiency
- Under the previously set conditions, measure the efficiency.
- Min E = 60%
- Max E = 99%

Sequence #6 – Line Regulation
- Set number of points to take measurements = 5
- Set low line voltage for Vin = 9 Vdc
- Set high line voltage for Vin = 36 Vdc
- Set I out1 & Iout2 = 0.4 A
- Min acceptable value = 0% delta
- Max acceptable value = 0.5% delta

Sequence #7 – Load Regulation
- Set number of points to take measurements = 6
- Set Vin = 24 Vdc
- Set low current = 0.04 A
- Set high current = 0.8 A
- Min acceptable value = 0%
- Max acceptable value = 1.0%

Sequence #8 – Cross Regulation
- Set number of points to take measurements = 6
- Set Vin = 24 Vdc
- Set I out1 = 0.4 A
- Set Iout2 low current = 0.2 A
- Set Iout2 high current = 0.6 A
- Set I out2 = 0.4 A
- Set Iout1 low current = 0.2 A
- Set Iout1 high current = 0.6 A
- Min acceptable value = 0%
- Max acceptable value = 2.0%

Sequence #9 – Current Limit Threshold
- Set Vin = 24 Vdc
- Set settling time set = 0.02 seconds
- Set threshold = 98% Vout
- Increase Iout in increments of 0.1 A
- Iout1 & Iout2 start at 0.8 A
- Min acceptable value = 1.0 A
- Max acceptable value = 2.0 A

Sequence #10 – Ripple Amplitude
- Set Vin = 24 Vdc
- Set Iout1 & Iout2 = 0.8 A
- Min acceptable measurement = 0
- Max acceptable measurement = 100 mVp-p