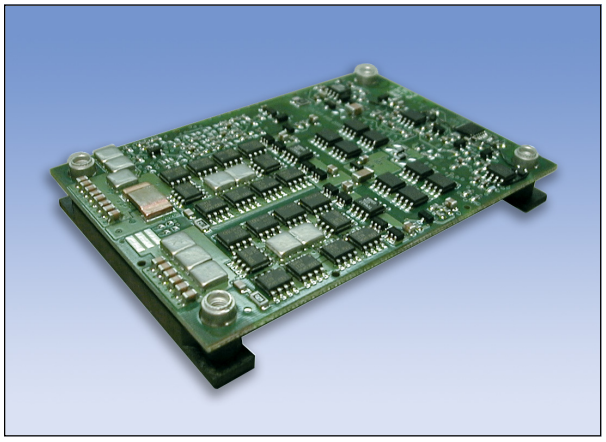
GALAXY POWER Incorporated

LEO SERIES

Industry's Highest Current DC/DC Converter.
48V or 24V Input, 250W, 120A Output,
3.3V 90A, 2.5V 100A, 1.8V 120A, 1.5V 120A, 1.2V 120A
standard with extra wide trim range



The open frame 3/4 brick Leo
is also available with an optional heatsink.

The Leo is a 3/4 brick CoolConverter™ in the Galaxy family of high-efficiency DC/DC converters.

- **Typical Efficiency: 91% at 1.8V, 60A; 88% at 1.8V, 120A**
- **Highest Ripple Frequency, 600kHz, for Low EMI**
- **Industry Compatible Footprint**
- **Democratic Secondary-side Current Sharing**
- **Ultra High Initial Setpoint Accuracy, ±0.2%**
- **Wide Trim Range, +10 to -70%**
- **Single Pole Transient Response (No Ringing)**
- **Rapid Turn-on from Valid Input Voltage**
- **Two Year Warranty**

CONTROL FUNCTIONS

- **Uses Patented Power Supply Control and Architecture**
- **Primary/Secondary Microprocessor Controlled**
- **Three Enable Signals Standard for Maximum Flexibility**
- **Differential Remote Sense**
- **Active High Power-Good Signal**

PROTECTION FEATURES

- **Over Temperature Protection**
- **Over Voltage Protection**
- **Under Voltage Lockout**
- **Delayed Lockout for Over Input Voltage**
- **Continuous Constant Current Limit**

TYPICAL CHARACTERISTICS

- **Output Setpoint Accuracy: ±0.2%**
- **Load Regulation: ±0.25%**
- **Line Regulation: ±0.25%**
- **Regulation over Line, Load, and Temperature: ±1%**

URS REGISTERED TO ISO 9001:2000 GALAXY POWER, INC. UKAS QUALITY MANAGEMENT 043-A

PRELIMINARY

GENERAL SPECIFICATIONS

V_{IN} = 48V_{DC}, T_A @25 °C, 300 LFM airflow, V_{OUT} = rated output voltage , I_{OUT} = Full Load unless otherwise noted.
Available output power depends on ambient temperature and good thermal management. (See application graphs for limits.)

Input Characteristics	**48V Series**		**24V Series**		
Parameter	**Min**	**Max**	**Min**	**Max**	**Units**
Operating Input Voltage	35.5	75.5	17.5	36.5	V_{DC}
Input Current (Model Dependent)		8.6		17	A
Input Capacitance		6.6		20	µF
Input Hysteresis, Low Line	1	3	1	3	V_{DC}
Reflected Input Ripple through 10µH with 47µF on input		1.5		20	mA_{RMS}
Control Signal Low Input Voltage[1]		1		1	V_{DC}
Control Signal High Input Voltage	4		4		V_{DC}
Maximum Input Voltage, non-operating		100		100	V_{DC}
No Load Input Current		70		100	mA
Output Characteristics					
Output Voltage, half-load, 48Vin, 25°C	99.8	100.2	99.8	100.2	$\%V_{NOM}$
Regulation Over Line, Load & Temperature	99	101	99	101	$\%V_{NOM}$
Voltage Ripple 5V		50		50	mV_{P-P}
5V		12		12	mV_{RMS}
≤ 3.3V		35		35	mV_{P-P}
≤ 3.3V		9		9	mV_{RMS}
Current Range 5V	0	60	0	45	A_{DC}
3.3V	0	90	0	85	A_{DC}
2.5V	0	100	0	100	A_{DC}
≤1.8V	0	120	0	120	A_{DC}
Short Circuit	105	125	105	125	$\%I_{MAX}$
Trim Range	-70	+10	-70	+10	$\%V_{NOM}$
Overvoltage Protection, Tracking, Latching	125	135	125	135	$\%V_{SET}$
Overvoltage Protection, Redundant, Latching	135	140	135	140	$\%V_{NOM}$
Isolation					
Isolation Test Voltage, Input/Output (Basic)	2250		2250		V_{DC}
Isolation Resistance	10		10		MΩ
Features					
Over-temperature Protection, Thermal Sensor[2]	120	125	120	125	°C
Input-output Capacitance	2200		2200		pF
Isense Signal, no load to current limit	0	2.5	0	2.5	V_{DC}
Ishare Accuracy (See application notes)	95	105	95	105	%
Power Good Range	95	105	95	105	$\%V_{SET}$
Power Good High Level	4.75	5.25	4.75	5.25	V_{DC}

Notes: 1. Internal pull up on both Control_L Primary and Secondary and Control_H pins are provided which source <0.2mA. For the module to operate Control_L needs to be low with respect to Vin(-) and Control_H needs to be high, or open-circuited.
2. PCB less than 130°C.

General Specifications

Operating Temperature		-40°C to +100°C
Storage Temperature		–55°C to +125°C
Relative Humidity		10% to 95% RH,Non-condensing
Vibration		2 to 9Hz, 3mm disp., 9 to 200Hz1g
Material Flammability		UL V-0
Weight (open frame)		55 grams
MTBF	Telcordia (Bellcore)	1,600,000 hours

Approvals and Standards

UL and c-UL Recognized Component, TUV pending, UL60950, CSA 22.2 No. 950, IEC/EN60950**

** *An external fuse shall be used to comply with the requirements.*

CoolConverter™ Family

Galaxy's **CoolConverter™** Family features:

- Patented single-stage power conversion architecture, control, and magnetic design allow unprecedented power density and efficiency in an isolated power supply.
- An advanced microcontroller reduces parts count while adding features, performance, and flexibility in the design.
- Low common-mode noise as a result of lower capacitance in the transformer compared to planar magnetics and metal baseplate designs.
- Higher reliability than planar transformer designs that can suffer from via fatigue from thermal cycling, and metal baseplate designs with board to board interconnects that are subject to mechanical stress on electrical connections.

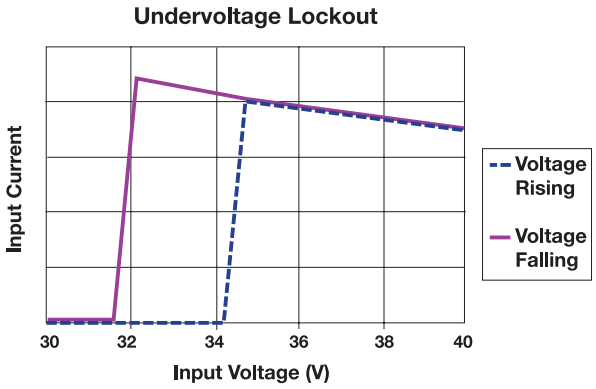
PROTECTION AND CONTROL

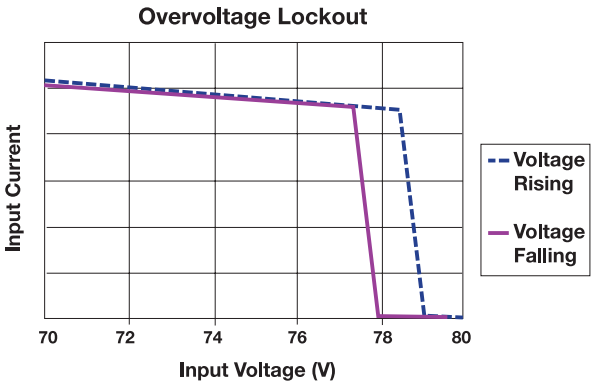
Valid Input Voltage Range:

The converter measures the input voltage and will not allow operation outside of the input voltage specification. As shown by the graphs, hysteresis is added to both the high and low voltage to prevent the converter from turning on and off repeatedly when the voltage is held near either voltage extreme. At low line this assures the maximum input current is not exceeded; at high line this assures the semiconductor devices in the converter are not damaged by excessive voltage stress. Shut down for over-input voltages is inhibited for 100 ms transients to prevent false shut down due to transient input voltage conditions.

ON/OFF Logic:

The Leo family of converters comes standard with both positive and negative logic input-side shutdown pins and positive logic secondary-side shutdown. All enable pins have internal pull-ups of approximately 0.2mA. The secondary-side enable allows for system sequencing without the need for an opto-isolator. For the converter to operate all negative logic enable inputs must be less than one volt and the positive logic enable must be greater than 4V or open-circuited.





Output Over Voltage Protection:

The output voltage is monitored in two ways, by the microcontroller which looks at the sensed signal and a high-speed comparator that measures the power pins. The microcontroller OVP allows the OVP circuit to track the trimmed signal. However, this circuit does not allow OVP signal detection in the event the voltage sense pins are shorted together. In that case, a redundant OVP set at a fixed threshold will prevent excessive voltage.

Thermal shutdown:

The printed circuit board temperature is measured using a semiconductor sensor. If the maximum rated temperature is exceeded, the converter is shutdown until the temperature decreases to 90 degC. The time for this depends on the airflow and heatsink mass.

Please consult Galaxy Power for your special needs.

Remote Sense:

The output voltage is regulated at the point where the sense pins connect to the power output pins. Total sense compensation should not exceed 0.4V or 10% of Vout, whichever is greater.

If the unit is trimmed up, the application requires that, under all conditions including current transients, the output voltage must be kept less than the redundant OVP, otherwise the unit will shutdown.

Safety:

An external input fuse must always be used to meet these safety requirements.

Trim:

The Leo converter has a novel regulation circuit that uses a differential measurement technique to eliminate voltage sense current. To trim the unit up, a resistor is connected from the trim pin to the Negative Sense pin. To trim the unit down, a resistor is connected from the trim pin to the Positive Sense pin. All models follow these trim equations:

$$R_{TRIM\ DOWN} = 2250/D - 30k\Omega$$

$$R_{TRIM\ UP} = 750/Dk\Omega$$

where D is the percentage of trim (i.e. 10 = 10%). For example, to trim up 10%, a 75kΩ resistor would be connected from the trim pin to the Negative Sense Pin.

Power Good Signal

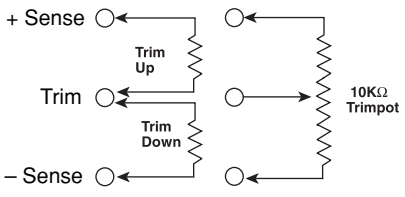
The Leo generates a power good signal when the output voltage falls in a 5% window of the nominal value. The circuit tracks the trimmed voltage. The circuit has a response time of approximately 1ms. The output signal is derived from an internal 5V power bus and can source up to 5mA. If interfacing to other logic is required, the output can drive a resistor divider to set a new high level. The voltage is referenced to the V_O(-) pin.

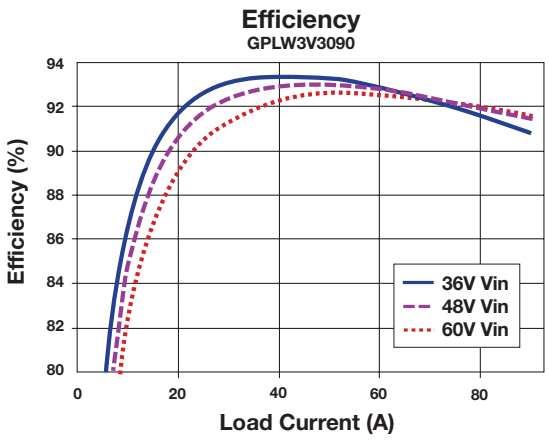
Transient Response and Stability

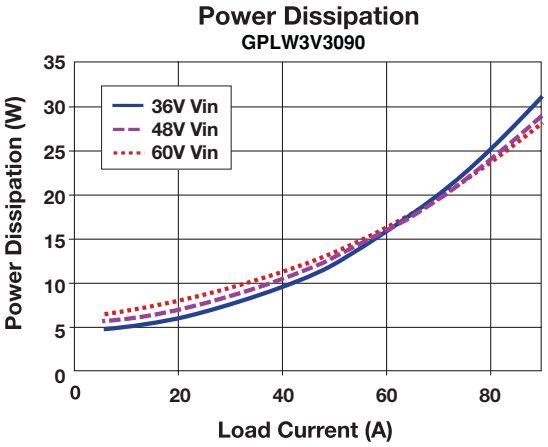
The Leo uses a high-bandwidth control to keep the output voltage in regulation. The crossover frequency of the Leo is approximately 15kHz (depending on the model) with greater than 60 degrees of phase margin. The control circuit maintains high phase margin at lower frequencies allowing the use of large amounts of external capacitance to be applies without loss of stability. If you require a high di/dt solution, Galaxy can adjust the gain of the control to take advantage of the on-board capacitance and improve the transient performance up to 5X the nominal value.

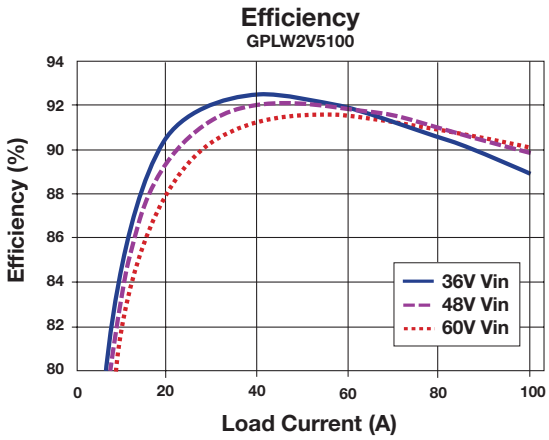
If several Leos are used in parallel with current sharing, the transient response is improved by the number of Leos. For example, with two Leos a 60A step will give the same response as a single Leo with a 30A step, or about 1/2 the peak over/undershoot.

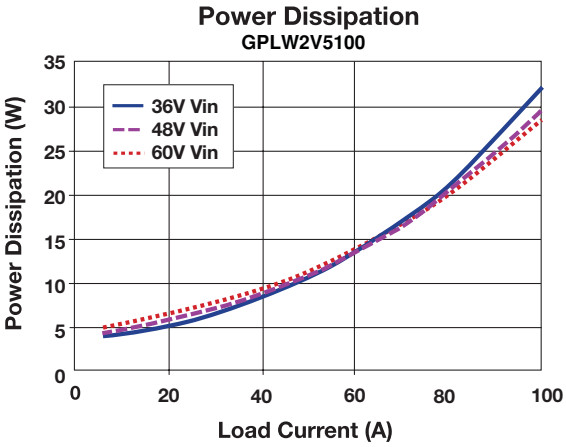
External Output Trimming

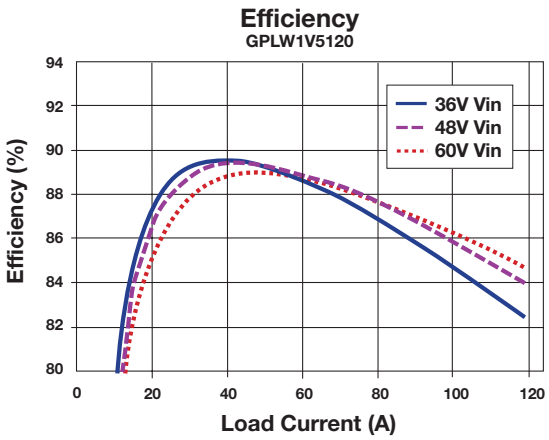


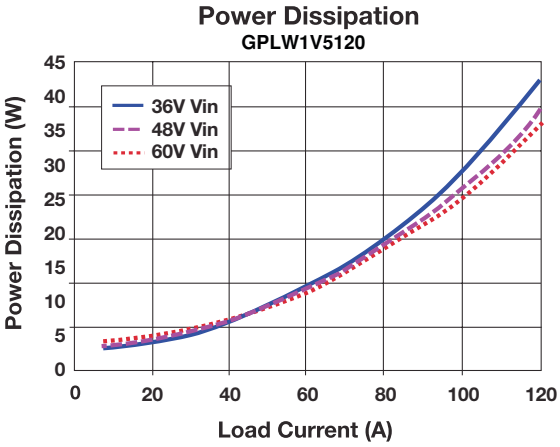

Efficiency
GPLW3V3090
Efficiency (%)
94
92
90
88
86
84
82
80
0
20
40
60
80
Load Current (A)
36V Vin
48V Vin
60V Vin


Power Dissipation
GPLW3V3090
Power Dissipation (W)
35
30
25
20
15
10
5
0
0
20
40
60
80
Load Current (A)
36V Vin
48V Vin
60V Vin

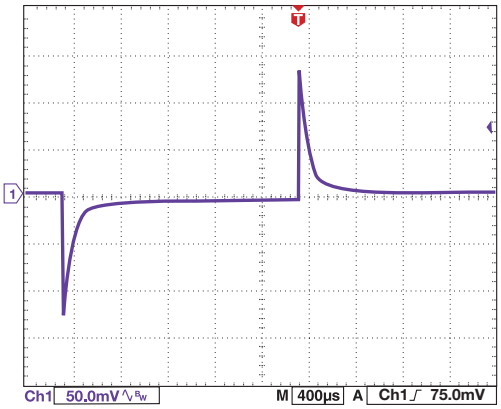

Efficiency
GPLW2V5100
Efficiency (%)
94
92
90
88
86
84
82
80
0
20
40
60
80
100
Load Current (A)
36V Vin
48V Vin
60V Vin


Power Dissipation
GPLW2V5100
Power Dissipation (W)
35
30
25
20
15
10
5
0
0
20
40
60
80
100
Load Current (A)
36V Vin
48V Vin
60V Vin

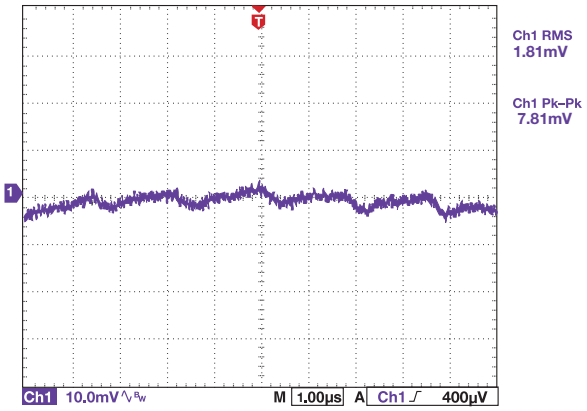

Efficiency
GPLW1V5120
Efficiency (%)
94
92
90
88
86
84
82
80
0
20
40
60
80
100
120
Load Current (A)
36V Vin
48V Vin
60V Vin


Power Dissipation
GPLW1V5120
Power Dissipation (W)
45
40
35
30
25
20
15
10
5
0
0
20
40
60
80
100
120
Load Current (A)
36V Vin
48V Vin
60V Vin

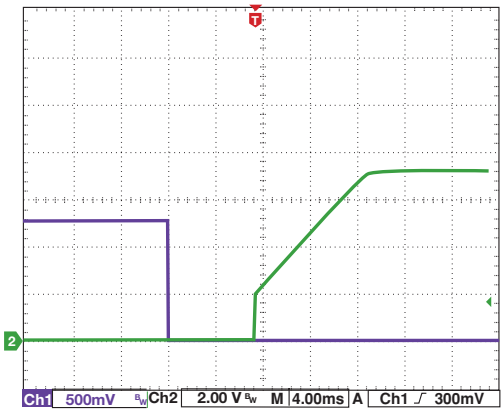
Transient Response



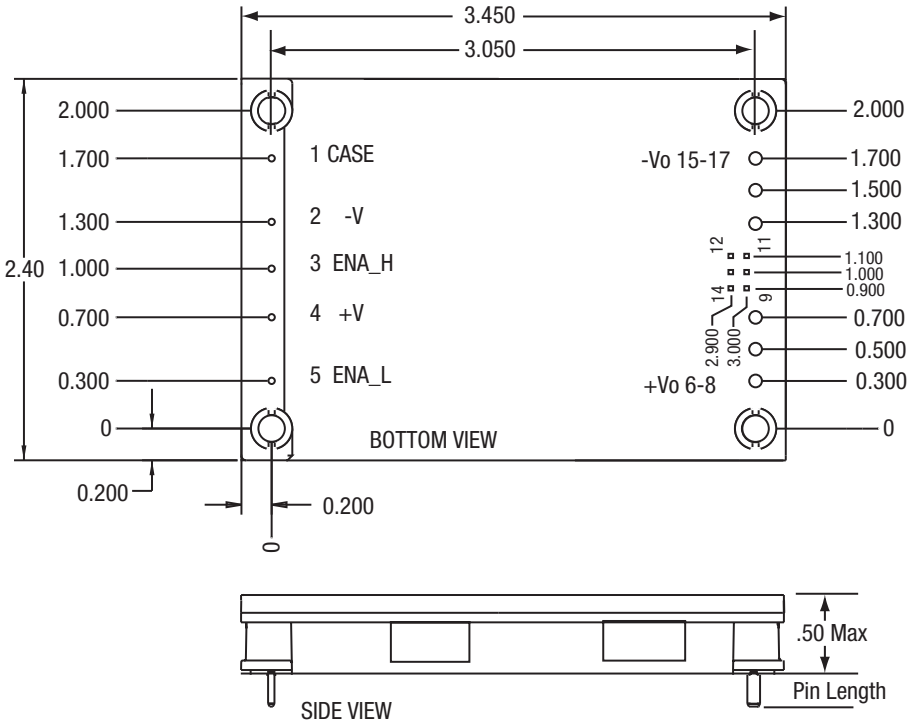
Voltage Ripple



Start-up Waveform



PACKAGE DETAIL



Pin No.	Function	Pin Dia. (in.)
1	Case	0.040 dia
2	-Vin	0.040 dia
3	ENA_H	0.040 dia
4	+Vin	0.040 dia
5	ENA_L	0.040 dia
6-8	+Vo	0.080 dia
9	+SEN	0.025 sq
10	TRIM	0.025 sq
11	-SEN	0.025 sq
12	P_GOOD	0.025 sq
13	ENA_H_S	0.025 sq
14	I_SHARE	0.025 sq
15-17	– Vo	0.080 dia

Notes:

1. Mechanical tolerances
   x.xxx in. = ±0.005 in.
   x.xx in. = ±0.01 in.
2. Pin material: brass with tin/lead plating over nickel
3. Workmanship: Meets or exceeds IPC-A-610B Class II

ORDERING INFORMATION

*Standard Model Number **	*Output Voltage*	*Max Current*	*Typical Efficiency Half Load*	*Full Load*
48V Input Models (Designated W)				
GPLW5V060	5.0V	60A	TBD	
GPLW3V390	3.3V	90A	93%	91%
GPLW2V5100	2.5V	100A	92%	90%
GPLW1V8120	1.8V	120A	90%	87%
GPLW1V5120	1.5V	120A	89%	84%
GPLW1V2120	1.2V	120A	TBD	

Heatsink Part Numbers

Part Number	*Height*	*Typical Thermal Performance Natural Convection Power Dissipation**	*Forced Convection Thermal Resistance***
001	0.25"	5W	5.8°C/W
002	0.50"	7W	3.2°C/W
003	1.00"	11W	2.0°C/W
004	0.13"	TBD	TBD

@ 60°C rise heatsink to ambient* * @ 300'/min.*

Ordering Information

Example Part No.:

GPLW5V060

48V Input
5.0V@60A Output
Negative Logic
0.20" Pin Length
Open Frame

Options Code:

(All options shown)

GPLW 1V8120 S T 00X

Part Number (from chart above)
Options:
Optional Pin Length
M = 0.145"
S = 0.12"
Tuned Model
Heatsink

*Standard Model Number**	*Output Voltage*	*Max Current*	*Typical Efficiency Half Load*	*Full Load*
24V Input Models (Designated C)				
GPLC5V050	5.0V	50A	TBD	
GPLC3V390	3.3V	90A	TBD	
GPLC2V5100	2.5V	100A	TBD	
GPLC1V8120	1.8V	120A	TBD	
GPLC1V8120	1.5V	120A	TBD	
GPLC1V2120	1.2V	120A	TBD	

** Options:*
M = 0.145" Pins (±0.01")
S = 0.12" Pins (±0.01")
*T = Tuned model***
Heatsinks optional, consult factory.

***T (Tuned Model) Option*

Designed for higher di/dt and ΔI applications, the transient response has been modified to take advantage of the capacitance on the customer's PCB. This unit requires a minimum load capacitance of 5600µF with an impedance magnitude of less than 0.005Ω at 15kHz. It offers a minimum 3X improvement in the peak response compared to a standard unit.

Galaxy Power Inc. warrants to the original purchaser that the products conform to this data sheet and are free from material and workmanship defects for a period of two (2) years from the date of manufacture, if this product is used within specified conditions. Galaxy Power Inc. reserves the right to make changes to the product(s) or information contained herein without notice. No liability is assumed as a result of their use or application. No rights under any patent accompany the sale of any such products or information. For additional details on this limited warranty consult the factory.

GALAXY POWER Incorporated
155 Flanders Road ◆ Westborough, MA 01581
508-870-9775 ◆ Fax: 508-870-9796
e–mail: galaxy@galaxypwr.com
website: http://www.galaxypwr.com

© Copyright 2002 Galaxy Power. Specifications subject to change without notice.