EXB100 Single
Application Note 129

ARTESYN TECHNOLOGIES

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- **Ultra high efficiency topology, 91.5% typical on EXB100-48S05 model**
- **Operating ambient temperature of -40°C to +90°C**
- **Approved to EN60950, UL/cUL1950**
- **Complies with ETS 300 019-1-3/2-3**
- **Complies with ETS 300 132-2 input voltage and current requirements**
- **Fully compliant with ETS 300 386-1**
- **Basic insulation (input to output)**
- **Industry standard half-brick pin-out**

1. Introduction

The EXB100 series is one of a new generation of DC/DC converters that were designed in response to the growing need for low operating voltage and higher efficiencies. The EXB100 offers very high efficiency figures and a wide range of low output voltage solutions.

In addition, the automated manufacturing methods, the use of planar magnetics and an extensive qualification program have resulted in one of the most reliable ranges of converters on the market.

2. Models and Features

The EXB100 series comprises three separate models as shown in Table 1. All popular integrated circuit operating voltages are covered by the entire range.

Model	Input Voltage	Output Voltage
EXB100-48S05	36-75VDC	3.0 to 5.5V
EXB100-48S3V3	36-75VDC	1.98 to 3.63V
EXB100-48S1V8	36-75VDC	1.08 to 1.98V

Table 1 - EXB100 Models

Features

- Industry standard half-brick pinout and footprint: 61.0 x 57.9 x 10.0mm (2.40 x 2.28 x 0.394 inches)
- Wide operating ambient temperature range of -40˚C to +90˚C
- Output voltage adjustability
- Remote sense compensation
- Primary-side controlled Remote ON/OFF
- Constant switching frequency
- Continuous overload and short circuit protection
- Over-temperature protection
- Output over-voltage protection
- Input under-voltage and over-voltage protection

3. General Description

3.1 Electrical Description

EXB100 power modules are DC/DC converters that provide an isolated, regulated DC output from a 36 to 75VDC input. The modules have maximum power ratings of 100W and excellent efficiencies are achieved by optimum driving of the synchronous rectification stage. The standard feature set includes Remote ON/OFF, remote sense and output trim for maximum flexibility in distributed power applications.

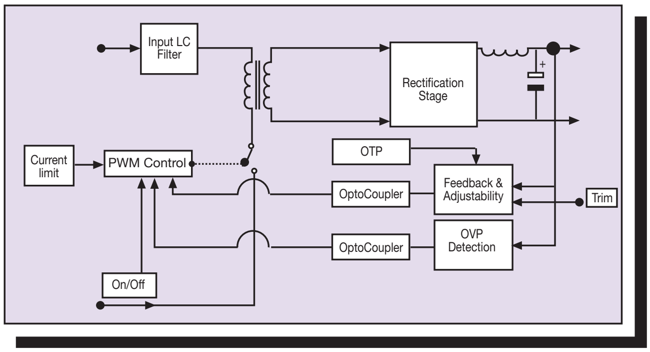

Figure 1 - Simplified Schematic

The DC input is filtered by an LC filter stage before it reaches the main power transformer. A current-controlled PWM controller is used to provide a precisely regulated output voltage. The main power switch is a MOSFET running at a constant switching frequency.

The output voltage at the sense pins of the module is sensed and compared with a secondary side reference and a compensated error signal is fed back via an optocoupler to the PWM controller. The secondary side trim pin allows the user to adjust the output voltage by connecting a resistor between trim and either the positive or negative output voltage sense pin.

The output over-voltage clamp consists of a second control loop, independent from the main regulation loop, that senses the voltage on the output power pins. This OVP loop has typically a 20% higher setpoint relative to the main loop. Further details on the OVP feature can be found in the applications section.

An over-temperature protection (OTP) circuit on the secondary side collapses the output voltage if the converter is in danger of being damaged. There is typically 10˚C of thermal hysteresis and this is used to protect the unit.

The Remote ON/OFF function allows the user to disable the converter, hence forcing the unit into a lower power dissipation mode.

The power transformer is of planar construction. Electrically, the transformer operates just the same as a conventional transformer. However, the advantages of a planar design are as follows:

- Excellent thermal characteristics
- Low leakage inductance
- Excellent repeatability properties

The rectification stage consists of synchronous rectifiers that are controlled by proprietary circuitry on the secondary side which optimise the driving scheme for high efficiency power conversion.

3.2 Physical Construction

The EXB100 is constructed using a single multi-layer FR4 PCB. SMT components are placed on both sides of the PCB and in general, the heavier power components are mounted on the top side in order to optimize heat dissipation.

The converter is sold as an open-frame product and no case is required. The open frame design has several advantages over encapsulated closed devices. Among these advantages are:

- **Cost:** No potting compound, case or associated process costs.
- **Thermals:** The heat is removed from the heat generating components without heating more sensitive, less tolerant components such as opto-couplers.
- **Environmental:** Some encapsulants are not kind to the environment and create problems in incinerators. In addition, open-frame converters are more easily re-cycled.
- **Reliability:** open-frame modules are more reliable for a number of reasons, including improved thermal performance and reduced TCE stresses.

A separate paper discussing the benefits of open-frame DC/DC converters (Design Note 102) is available at www.artesyn.com

4. Features and Functions

4.1 Wide Operating Temperature Range

The wide ambient temperature range of the EXB100 module is a consequence of the extremely high efficiency achieved and resultant low power dissipation. Operation from -40˚C to a maximum ambient temperature of +90˚C is achieved without the requirement for heatsinks, making the EXB100 ideally suited to cost and space sensitive applications.

4.2 Remote Sense Compensation

The EXB100 has a remote sense feature to compensate for moderate voltage drops in the distribution system. Thus, accurate voltage regulation can be achieved directly at the load terminals. Further details concerning the remote sense compensation feature are presented in the applications section.

4.3 Output Voltage Adjustment

The output voltage on all models is trimmable by -40% to +10% of the nominal output voltage. Details on how to trim all models are provided in the applications section.

4.4 Remote ON/OFF

The Remote ON/OFF function allows the unit to be controlled by an external signal that puts the module into a low power dissipating sleep mode. Methods of using this function are given in the applications section.

4.5 Constant Switching Frequency

The switching frequency for all models is fixed at approximately 300kHz for the 5V model and 220kHz for the 3V3 and 1V8 models, and is independent of line and load levels. This makes the overall power system more predictable and greatly simplifies the design of the input filter required for EMC compliance.

4.6 Current Limit and Short Circuit Protection

All models of the EXB100 have continuous current limit and short circuit protection. Once the overcurrent condition (or a short circuit on the output) persists for typicaly 50ms the unit will enter a 'hiccup' mode of operation as shown in Figure 2. The current limit inception point is dependent on the input voltage, ambient temperature and has a parametric spread. For all models the inception point is typically 115%. It may go as high as 140% over all operating conditions. The duty cycle of the hiccup depends on the level of over-current. This mode of operation will continue indefinitely until the over-current condition is corrected.

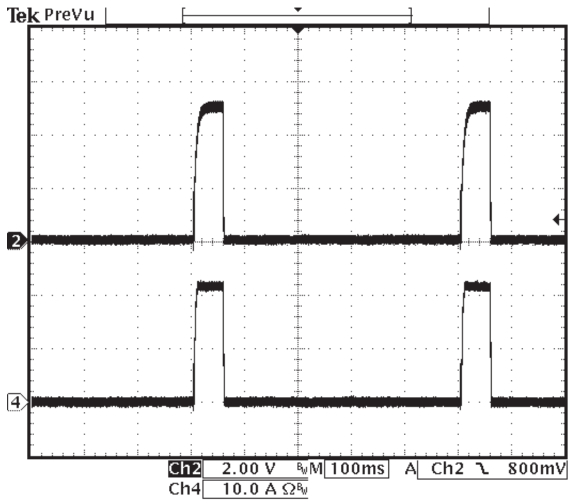

Figure 2 - Typical V and I Characteristics During Overload (EXB100-48S05)

None of the specifications are guaranteed when the unit is operated in an over-current condition. The unit can be operated continuously in this condition but the lifetime of the converter will be reduced.

4.7 Over-temperature Protection

This feature is included as standard in order to protect the converter and the circuitry it powers from overheating in the event of a runaway thermal condition such as a fan failure at high temperature or continuous operation above the maximum ambient temperature.

The actual ambient temperature at which the over-temperature circuit trips depends on a number of factors. The airflow over the unit is the most dominant. The trip point is also affected by the input voltage, output trim voltage, user PCB layout, output load and model.

The over-temperature sensor is placed close to the secondary side synchronous rectifiers as these are the components most likely to be stressed in an over-temperature condition. The over-temperature level is set such that the synchronous rectifier junction temperature does not exceed 130˚C (the manufacturers rating for the part is 150˚C) during an over-temperature condition. Note that during an over-temperature condition the average PCB temperature will be much lower than the synchronous rectifier's junction temperature, particularly if the output current is not at the maximum level.

During normal operation, the temperature at the over-temperature sensor should always be kept below 105˚C to prevent false triggering of the OTP circuit. This will ensure that the junction temperature of the rectifiers at Vin,nom and Iout,max is limited to approximately 115˚C when operated at maximum ambient temperature.
The protection mechanism is similar to the over-current condition. Once an over-temperature is detected the output voltage collapses, forcing the temperature to decrease. When the output current is reduced, the temperature at the sensor location drops rapidly and the unit will automatically turn on again. If the condition that is causing the over-temperature has not been removed the output voltage will collapse once again and the cycle is repeated.

None of the specifications are guaranteed when the unit is operated in an over-temperature condition. The unit can be operated continuously in this condition. However the lifetime of the unit will be reduced.

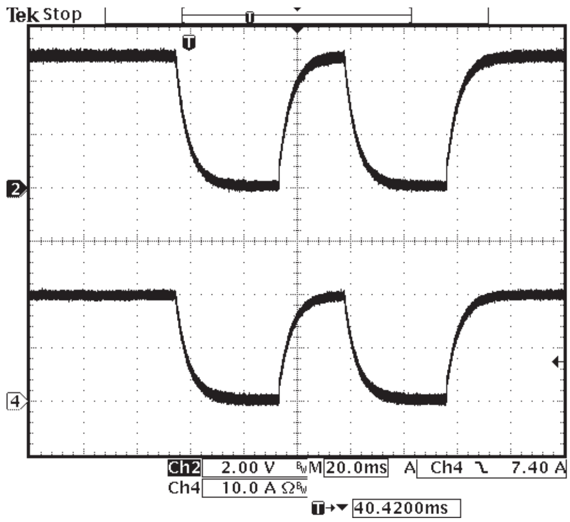

Figure 3 - Characteristic Response of OTP Circuit

4.8 Output Over-voltage Protection

The clamped over-voltage protection (OVP) feature is used to protect the module and the user's circuitry when a fault occurs in the main control loop. The unit is protected in the event that the output is trimmed above the recommended maximum specification.

The OVP circuit consists of an auxiliary control loop running in parallel to the main control loop and using a separate optocoupler. However, unlike the main loop, the OVP loop senses the voltage at the output power terminals of the module, Vo+ and Vo-. The sensed voltage is compared to a separate OVP reference and a compensated error signal is generated such that the output voltage is regulated to the OVP clamp level. The clamp levels are given in Table 2.

Output Voltage	Clamp Level
1.8V	2.2V
3.3V	3.9V
5V	6.0V

Table 2 - OVP Trip Point

4.9 Input Under-voltage and Over-voltage Protection

The EXB100 series is fitted with a detection circuit at the input side that inhibits operation of the converter when the input voltage is outside the normal operating range. The converter is disabled when the input voltage is below 32V or above 78V approximately. The lower trip value protects against deep discharge of telecom batteries while the upper level protects the module from operating beyond the maximum input voltage rating. The thresholds also have inherent hysteresis to provide immunity against slow ramping input voltages. The module operates in a low power dissipation mode when protected.

5. Safety

5.1 Isolation

The EXB100 has been submitted to independent safety agencies and has EN60950 and UL60950 safety approvals. Basic insulation is provided and the unit is approved for use between the classes of circuits listed in Table 3.

Insulation	
Between	**And**
TNV-1 Circuit	Earthed SELV Circuit Unearthed SELV Circuit
TNV-2 Circuit TNV-3 Circuit	Earthed SELV Circuit Unearthed SELV Circuit or TNV-1 Circuit
Earthed or Unearthed Hazardous Voltage Secondary Circuit	Earthed SELV Circuit ELV Circuit Unearthed Hazardous Voltage Secondary Circuit TNV-1 Circuit

Table 3 - Insulation Categories for Basic

The TNV or Telecommunication Voltage definitions are given in Table V.1 of IEC950 from which EN60950 and UL60950 are derived.

The EXB100 has an approved insulation system that satisfies the requirements of the safety standards.

5.2 Input Fusing

In order to comply with safety requirements the user must provide a fuse in the unearthed input line if an earthed input is used. The reason for putting the fuse in the unearthed line is to avoid earth being disconnected in the event of a failure. If an earthed input is not being used then the fuse may be in either input line.

A 5A HRC 200V fuse is recommended for the EXB100 series.

6. EMC

The EXB100 has been designed to comply with the EMC requirements of ETSI 300 386-1. It meets the most stringent requirements of Table 5; Public telecommunications equipment, locations other than telecommunication centres, High Priority of Service.

6.1 Conducted Emissions

The required standard for conducted emissions is EN55022 (FCC Part 15). The EXB100 has a substantial filter on board that greatly reduces conducted emissions. However, external filter networks are required if the module is to meet EN55022 Class A and Class B standards. Putting these extra components on board the EXB100 would have added to the cost and footprint of the module. Additionally, this would have removed the flexibility that end users have to add a single filter to the input of all converters on a card, thereby reducing cost and space.

The Class B conducted noise plot for the EXB100-48S3V3 is shown in Figure 4. The filter circuit to achieve this result is shown in Figure 5. All other models have similar curves and are available on request. A similar filter can be derived for Class A compliance using the same component set.

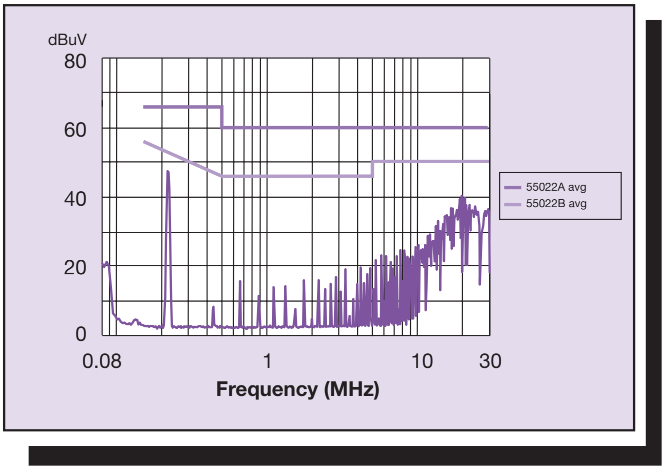

Figure 4 - Conducted Noise Measurements on EXB100-48S3V3 (Level A and Level B Limit Lines Shown)

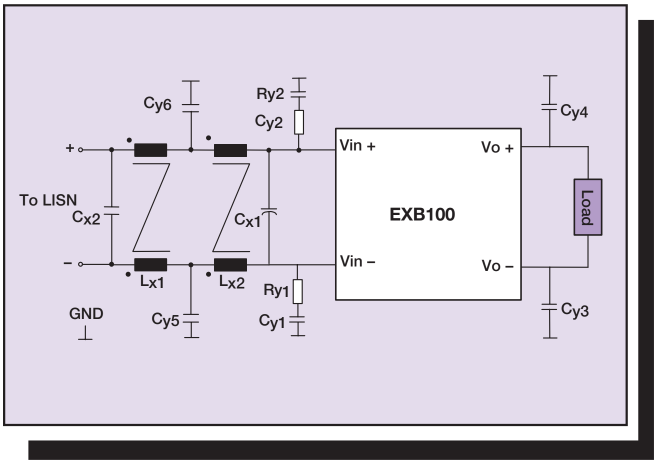

Figure 5 - Required Filter for Class B Compliance on 48V Models

Manufacturers part numbers for the components used are as follows:

Cx2, ITW Paktron 4µF 100V SMT film capacitor, 405K100CS44
Cx1, 33µF 100V electyrolytic Capacitor
Ry1, Ry2 10Ω 1206 resistor
Lx1, Lx2 Pulse Eng PO420
Cy1, Cy2, Cy5, Cy6 AVX 5.6nF, 1kV, 1812
Cy3, Cy4 AVX, 2.2nF 2kV 1812

The components specified are for indication only, the end user needs to ensure that these components are within specification for their application.

6.2 Radiated Emissions

The applicable standard is EN55022 Class B (FCC Part 15). Testing DC/DC converters as a stand alone component to the exact requirements of EN55022 (FCC Part 15) is very difficult as the standard calls for 1m leads to be attached to the input and output ports and aligned in order to maximise the disturbance. In such a set-up it is possible to form a perfect dipole antenna that very few DC/DC converters could pass.

However the standard also states that 'An attempt should be made to maximise the disturbance consistent with the typical application by varying the configuration of the test sample'.

The unit, tested by an independent accredited open area test site, was mounted on a test card with the filter specifed in Figure 5. A metal enclosure should provide further attenuation to emissions in the frequency range 30MHz to 1GHz.

Measurements of radiated emssions were carried out from 30MHz to 1GHz at a distance of 10m.

The operating conditions were as follows:

- Input Voltage, Vin = 48V
- Output Voltage, Vo = 5V
- Output Current, Io = 20A

The module orientation, along with the height and polarisation of the antenna, was investigated to ensure that maximum emissions were obtained. The maximum emission levels recorded are shown in Table 4. This shows that the unit passes the level A criterion.

Frequency	Q.P Level dB (µV/m)	EN55022 Limit dB (µV/m)	Antenna Pol. Vert/Horiz	Antenna Height (m)	EU Angle
32.672	33.7	40.0	Vertical	1.000	4°
46.828	27.9	40.0	Vertical	1.000	275°
53.188	27.2	40.0	Vertical	1.000	18°
73.412	29.6	40.0	Vertical	1.434	168°
123.508	31.4	40.0	Vertical	1.000	282°
142.416	31.5	40.0	Vertical	1.000	137°
177.920	25.8	40.0	Vertical	1.000	30°

Table 4 - Radiated Emission Measurements from EXB100-48S05 on an Open Area Test Site at 10 metres

An initial prescan (measured at approx. 3 metres in an anechoic chamber) is shown in Figure 6. This plot is for indication purposes only.

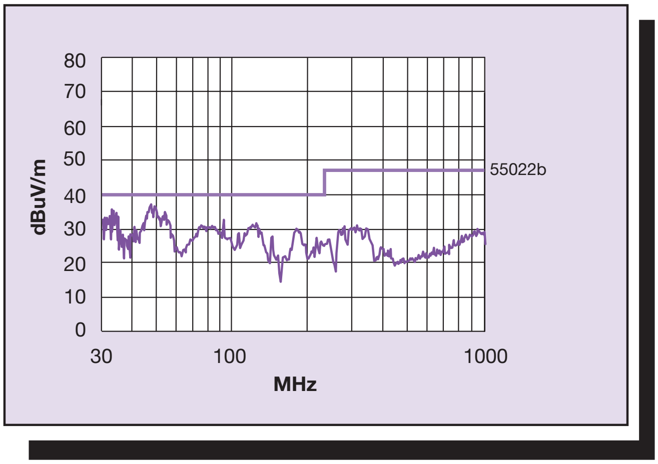

Figure 6 - Prescan of Radiated Emissions in Anechoic Chamber at 3 metres

7. Use in a Manufacturing Environment

7.1 Resistance to Soldering Heat

The EXB100 is intended for PCB mounting. Artesyn has determined how well it can resist the temperatures associated with the soldering of PTH components without affecting its performance or reliability. The method used to verify this is MIL-STD-202 method 210D. Within this method two test conditions were specified, Soldering Iron condition A and Wave Solder condition C.

For the soldering iron test, the UUT was placed on a PCB and a soldering iron, set to 350°C ±10°C, was applied to each terminal for 5 seconds. The UUT was then removed from the test PCB and was examined under a microscope for any reflow of the pin solder or physical change to the terminations. None was found.

For the wave soldering test, the UUT was again mounted on a test PCB. The unit was wave soldered using the conditions shown in Table 5.

Temperature	Time	Temperature Ramp
260°C ±5°C	10s±1	Preheat 4°C/s to 160°C. 25mm/s rate

Table 5 - Wave Solder Test Conditions

The UUT was inspected after soldering and no physical change on pin terminations was found.

7.2 Water Washing

The EXB100 is suitable for water washing as it doesn't have any pockets where water may congregate long-term. The user should ensure that a sufficient drying process and period is available to remove the water from the unit after washing.

7.3 ESD Control

The EXB100 units are manufactured in an ESD controlled environment and supplied in conductive packaging to prevent ESD damage occurring before or during shipping. It is essential that they are unpacked and handled using approved ESD control procedures. Failure to do so could affect the lifetime of the converter.

8. Applications

8.1 Thermal Performance

The electrical operating conditions of the EXB100, namely

- Input voltage, Vin
- Output voltage, Vo
- Output current, Io

determine how much power is dissipated within the converter.

Together with the environmental operating conditions, namely

- Ambient temperature
- Air velocity
- Thermal efficiency of the end system application
- Components mounted on system PCB that may block airflow
- Thermal characteristics of system PCB
- Real airflow characteristics at the converter location
- PCB orientation.

will determine the temperature of the thermal reference points shown in Figure 9. The maximum acceptable temperatures of the thermal reference points are indicated in the datasheet. The temperature at these points is limited to comply with Artesyn's stringent component de-rating criteria.

To simplify the thermal design, a number of graphs are given in the datasheet. The set of de-rating graphs shows the load current of the EXB100 converters versus the ambient air temperature and forced air velocity. The thermal measurement set-up is shown in Figure 8. The set-up can be summarised as follows,

- The module is mounted on a 2-sided 230mm x 125mm PCB testcard. (If the user were to use a multilayer PCB, it will further increase the heatsinking ability of the system and this will result in reduced component temperatures.)
- A second card (with virtually no copper traces) of the same size is attached to the test card at a distance of 25mm apart. This will encourage laminar airflow through the channel created by the parallel cards. Turbulent airflow would further enhance the operation of the unit.
- The airflow is measured directly in front of the module as shown in Figure 8. The velocity of the air is measured using a vane-probe anenonmeter. Ambient temperature is measured on the facing card at a distance of approx. 80mm from the module under test. Measuring the ambient temperature closer to the module will result in a higher temperature being recorded due to localised heating caused by the module. This would give the impression that the ambient temperature is higher than it actually is and therefore produce overly optimistic thermal de-rating curves.
- The measurements have been taken from a module of average efficiency. The module is allowed to stabilise before measurements are made.
- During thermal testing, the module is mounted in the orientation shown in Figure 9. These tests provide an indication of the thermal performance of the products in an average application. Optimal thermal performance will be achieved by placing the synchronous rectifiers in direct line of airflow.

To ensure compliance with safety regulations, a number of keep out areas are identified on the top side of the user board. These are shown in Figure 7.

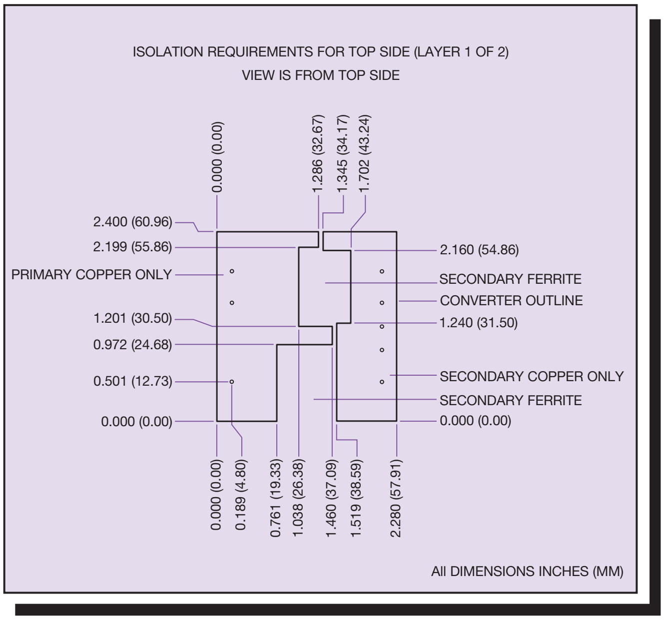

Figure 7 - Keep Out Areas on Top Side of User PCB to Meet Safety Spacing Requirements

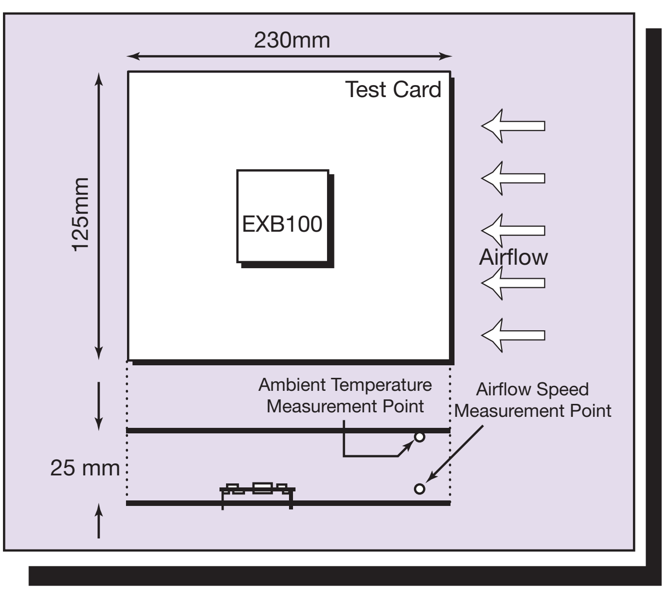

Figure 8 - Airflow Measurement Set-up

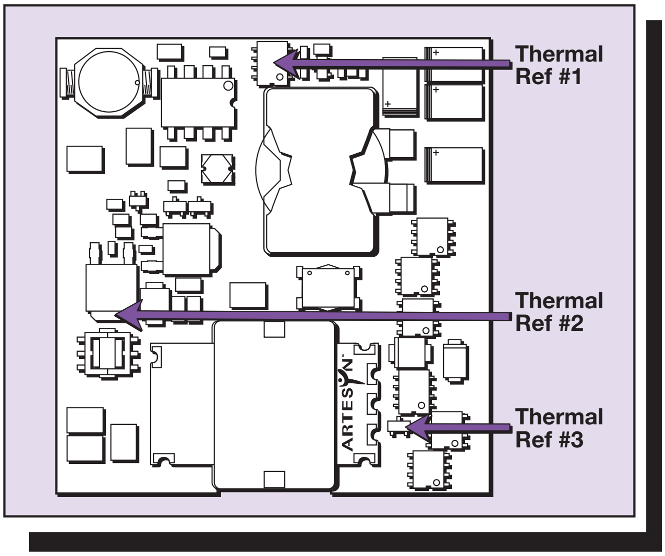

Figure 9 - Thermal Reference Points on EXB100

8.2 Remote ON/OFF Control
The Remote ON/OFF control feature allow the user to switch the converter on and off electronically when the appropriate signal is applied to the remote pin. This is a primary-referenced function that allows the converter be put in a low power dissipation sleep mode.

The EXB100 models are available with both positive and negative logic Remote ON/OFF configurations. In each configuration, the control pin is held high by an internal resistor.

8.3 Positive Logic
This means that for the active high model, no connection is needed to the control pin for the module to be enabled. However, the control pin needs to be driven low and kept low to put the module into sleep mode.

8.4 Negative Logic
This means that for the active low model, the control pin must be held low to be enabled. However, the control pin needs to be pulled high or left floating to put the module into sleep mode. To order a module with negative logic, add suffix '-R' to the part number.

8.5 Specification for the Remote ON/OFF
See signal electrical interface on the EXB100 long form data sheet.

8.6 Isolated Closure Remote ON/OFF
An isolated closure is a closure with both high and low impedance states that sinks current, but does not source current. For ON/OFF control the closure is between the on/off pin and Vin-, this can be a device such as a mechanical switch, open collector transistor or opto-isolator.

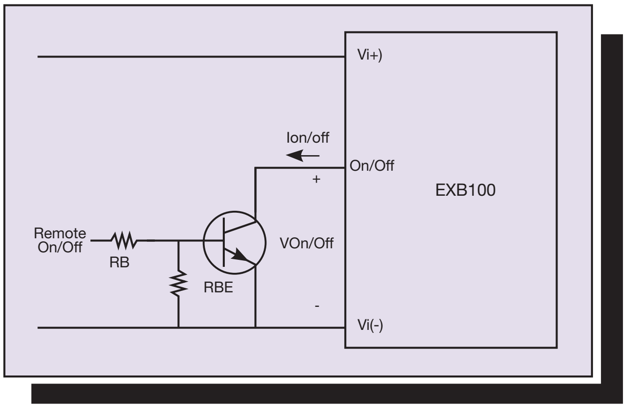

Figure 10- Isolated Closure using a Transistor

Note in the data sheet, that the maximum acceptable leakage current is 50µA. The isolation device should have a leakage current less than this value or the module may go into a low power dissipation mode (remote OFF).

8.7 Level Controlled Remote ON/OFF

Units can also be controlled by applying a voltage to the Remote ON/OFF pin. The figure below shows a TTL output control.

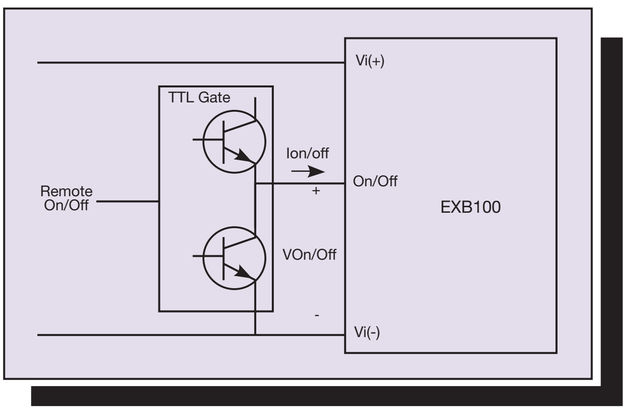

Figure 11 - Level Control using TTL Output

As per the data sheet, the TTL must be capable of sinking the maximum low level input current of 100µA.

8.8 Remote Sense Compensation

The remote sense compensation feature minimises the effects of resistance in the distribution system and facilitates accurate voltage regulation at the load terminals or another selected point. The remote sense lines will carry very little current and hence do not require a large cross-sectional area. However, if the sense lines are routed on a PCB, they should be located close to a ground plane in order to minimise any noise coupled onto the lines that might impair control loop stability. In a discrete wiring situation, the use of a twisted pair or any other technique to reduce noise susceptability is recommended. A small 100nF ceramic capacitor can be connected, see Figure 12, at the point of load to decouple any noise on the sense wires.

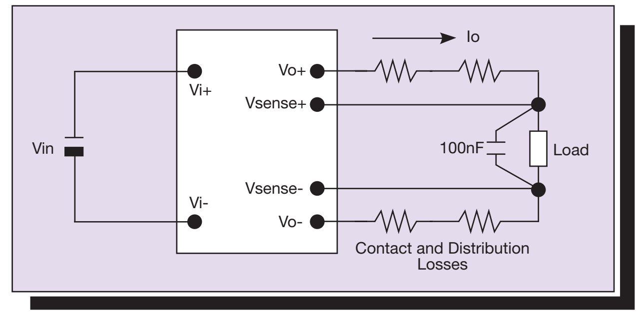

Figure 12- Circuit Configuration for Remote Sense Operation

The power module will typically compensate for a maximum drop of 10% of the nominal output voltage. In other words, the voltage difference between the power terminals and the sense terminals must not exceed the maximum output sense range specified in the data sheet, i.e.

[Vo+ - Vo-] - [Vsense+ - Vsense-] < 10% Vo(nom)

However, if trim up and remote sense are used in combination, the over-voltage setpoint might be reached and the output voltage at the power terminals will be clamped at this level. Long-term operation under this condition will adversely affect the reliability of the unit.

If the remote sense feature is not required, it is necessary to short the sense terminals to the respective power terminals as shown in Figure 13.

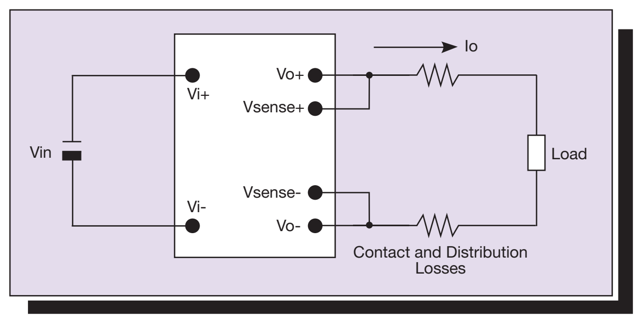

Figure 13 - Circuit Configuration when Remote Sense is not required

Output Voltage Adjustment

The output can be externally trimmed by -40% to +10% by connecting an external resistor between the TRIM pin and either of the output voltage sense pins.

With an external resistor between TRIM and Vsense+, (R_{ADJ_UP}) the output voltage setpoint increases (See Figure 14). Conversely, connecting an external resistor between TRIM and Vsense-, (R_{ADJ_DOWN}), the output voltage setpoint decreases (See Figure 15).

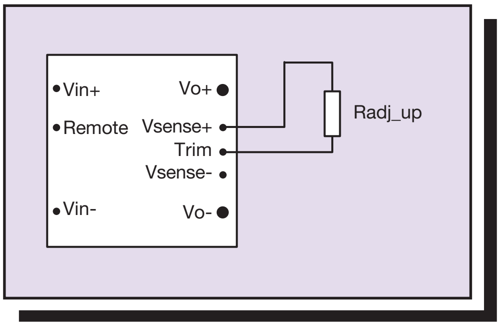

Figure 14- Circuit Configuration to Increase Output Voltage

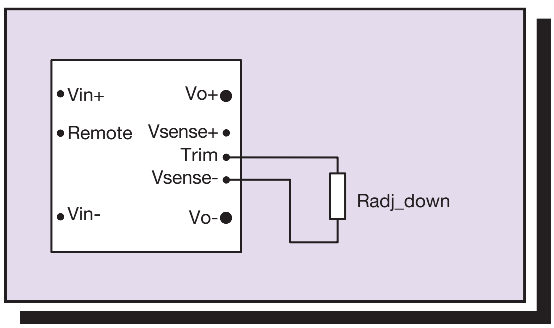

Figure 15 - Circuit Configuration to Reduce Output Voltage

The equations used to determine the value of the external resistor (specified in kΩ) required to obtain the desired output voltage are shown below:

$$R_{ADJ\_DOWN} = \left(\frac{1}{\Delta} - 2\right) k\Omega$$

$$R_{ADJ\_UP} = \left[\frac{(1+\Delta) * Vo,nom}{\Delta * 1.225} - \frac{1+2 * \Delta}{\Delta}\right] k\Omega$$

Where,

Vo,nom	is the default output voltage of the module
Δ	% change expressed in decimals, e.g. for 30% trim down, $\Delta = 0.3$
R_{ADJ_DOWN}	the resistor required to achieve the desired trimmed down output voltage
R_{ADJ_UP}	the resistor required to achieve the desired trimmed up output voltage

Example:
To trim up the 5V model by 6% to 5.3V the required external resistor is:

$$R_{ADJ\_UP} = \left[\frac{1 + 0.06 * 5}{0.06 * 1.225} - \frac{1 + 2 * 0.06}{0.06}\right] k\Omega$$

$$R_{ADJ\_UP} = \left[\frac{5.3}{0.0735} - \frac{1.12}{0.06}\right] k\Omega$$

$$R_{ADJ\_UP} = 53.5 k\Omega$$

To trim down the 3V3 model by 25% to 2.475V the required external resistor is:

$$R_{ADJ\_DOWN} = \left(\frac{1}{0.25} - 2\right) k\Omega$$

$$R_{ADJ\_DOWN} = (4 - 2) k\Omega$$

$$R_{ADJ\_DOWN} = 2 k\Omega$$

Note that the resistor required to trim down is independent of output voltage, whereas the resistor required to trim up is largely dependent on output voltage.

For both the 5V and 3V3 models, when the output voltage is trimmed up by a certain percentage, the output current must be derated by the same amount so that the maximum output power of 100W is not exceeded.

A plot of the required trim resistor for each model is shown in Figure 16 for trim-down and in Figure 17 for trim-up.

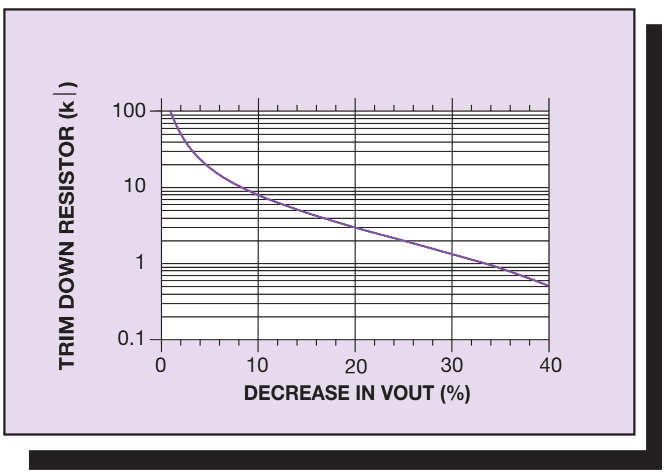

Figure 16 - Trim Down
Resistor vs. Percentage Change in Output Voltage

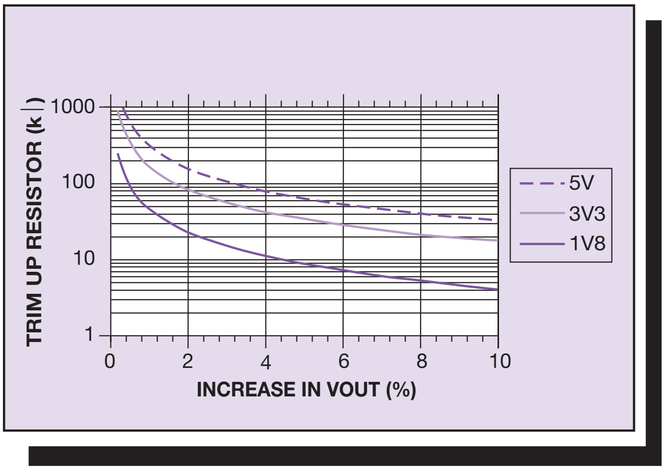

Figure 17 - Trim Up
Resistor vs. Percentage Change in Output Voltage

8.9 Output Voltage Adjustment Accuracy

The accuracy of the adjusted output voltage is dependant on the tolerance of the external trim resistor and the tolerance of some internal components.

If the required value of trim resistor used externally (as calculated from the above equations) is accurate to within 5%, then the nominal setpoint accuracy of the required output voltage will increase from a maximum of 1.5% to 2.25%.

8.10 Output Capacitance

The EXB100 has been designed for stable operation without the need for external capacitors at the input or output terminals when powered from a low impedance source. However, when powering loads with large dynamic current requirements, improved voltage regulation can be obtained by inserting decoupling capacitors as close as possible to the load. Low ESR ceramic capacitors will handle high frequency current components while tantalum capacitors can be used to supply the lower frequency dynamic current variations. Note that the absolute maximum value of output capacitance is 10,000µF. Please contact your local Artesyn Technologies representative if you wish to use higher values of capacitance.

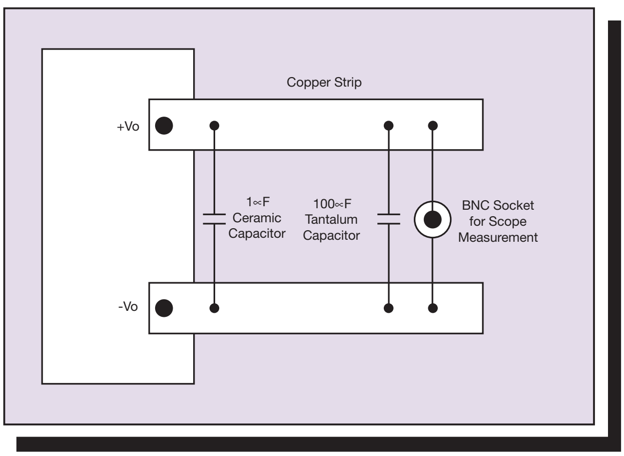

Figure 18 - Output Ripple and Noise Measurement Set-up

8.11 Output Noise and Ripple Measurement

The above circuit has been used for noise measurement on EXB100 series converters. A 50Ω coax lead should be used with a termination impedance of 50Ω. This will prevent impedance mismatch reflections that would otherwise disturb the noise reading at high frequency. Ensure that the 100µF tantalum capacitor is placed as close as possible to the BNC socket for best results.

8.12 Reflected Input Current Measurement

The circuit shown in Figure 19 has been used to measure the reflected input current. Capacitor Cin is used to offset any impedance that may occur between the converter and the battery.

This filter may be connected on the input side of the EXB100 to reduce the reflected input ripple current.

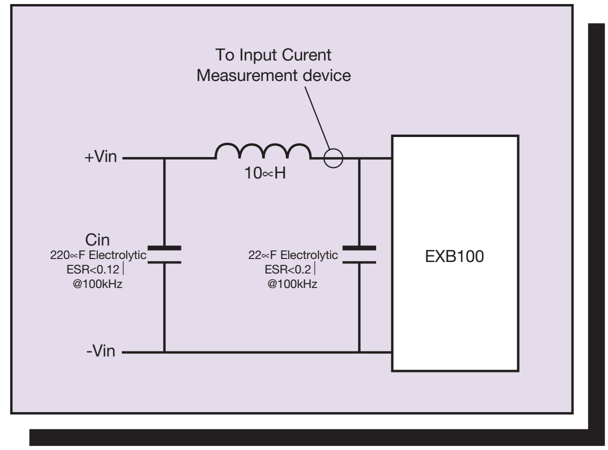

Figure 19 - Reflected Ripple Current Measurement Set-up with Recommended Filter for Ripple Current Reduction

8.13 Parallel Operation

As no active current sharing feature is employed, parallel operation of multiple EXB100 converters is not recommended. If unavoidable, Oring-diodes must be used to decouple the outputs. Droop resistors will support some passive current sharing. It should be noted that both measures will adversely affect the power conversion efficiency.

8.14 Compatability with ADM1070 Hot Swap Controller

Inserting circuit boards into a live -48V backplane can cause large input transient currents when large capacitances are charged. These transient currents can cause glitches on the system power supply and permanently damage components on the board. To ensure that the input voltage is stable and within tolerance before being applied to the DC-DC converter, Artesyn Technologies recommends the use of a hot-swap controller, such as the ADM1070 from Analog Devices. This device controls harmful transient currents and ensures safe insertion or removal of the application board from a live backplane.

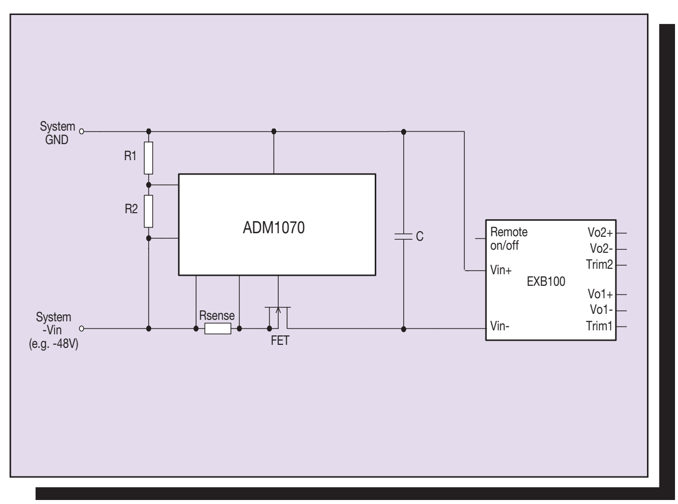

Figure 20 - Inrush Current Control using ADM1070

The ADM1070 is a 6-pin SOT-23, negative voltage hot-swap controller that allows a board to be safely inserted and removed from a live backplane. This product is compatible with the EXB100 family.

The ADM1070 provides the following features:

- Inrush current is limited to a programmable value by controlling the gate voltage of an external N-channel pass transistor
- The pass transistor is turned off if the input voltage is less than the programmable under-voltage threshold or greater than the over-voltage threshold. A programmable electronic circuit breaker protects the system against shorts.

The UV/OV pin can be used to detect under-voltage and over-voltage conditions at the power supply input. The EXB100 already has in-built under-voltage protection to ensure that the unit does not draw power from the source for voltages less than approximately 30V. Users should refer to the data sheet of the ADM1070 for details on setting the required UVLO and OVLO trip levels.

The ADM1070 features a current limiting function that protects against short circuits or excessive supply currents. The flow of current through the load is monitored by measuring the voltage across the sense resistor, R_{sense}. The action taken by the controller in the event of an input over-current condition will depend upon the severity of that condition. Please refer to the ADM1070 product datasheet on **www.analog.com** for details.