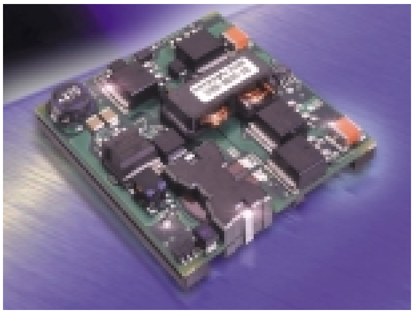
EXB30 DUAL SERIES

Application Note 109 Rev. 02 - Sept. 2000

NEW Product



- **Two independent positive outputs**
- **Output voltage tracking**
- **High efficiency**
- **Approved to EN60950, UL/cUL1950**
- **Operating ambient temperature of -40°C to +70°C (natural convection)**
- **Up to 100% load imbalance**
- **Separate trim on each output**
- **No minimum load**
- **Complies with ETS 300 019-1-3/2-3**
- **Fully compliant with ETS 300 386-1**

1. Introduction

The EXB30 Dual series is a family of open-frame DC/DC converters providing two positive outputs. High-efficiency operation is achieved through the use of synchronous rectification and planar magnetics. Both outputs are independently regulated, and independently trimmable. The specified maximum output current can be drawn from the outputs in any load combination. The tracking feature guarantees that the voltage difference between the outputs during start-up does not exceed a specified limit. A remote on/off feature and latching overvoltage protection for both outputs are included as standard. OVP latches are enabled by default, but can be disabled by the user.

Automated manufacturing methods together with an extensive qualification program have produced a highly reliable range of converters.

2. Models and Features

The EXB30 Dual series comprises four models as shown in Table 1. Popular integrated circuit operating voltages are covered by the entire range.

Model	Input Voltage	Output Voltage
EXB30-24D05-3V3	18-36VDC	5V/3.3V
EXB30-24D3V3-2V5	18-36VDC	3.3V/2.5V
EXB30-48D05-3V3	36-75VDC	5V/3.3V
EXB30-48D3V3-2V5	36-75VDC	3.3V/2.5V

Table 1 - EXB30 Models

Features

- Industry standard half-brick pinout and footprint: 61.0 x 57.9 x 12.7mm (2.40 x 2.28 x 0.50 inches)
- Wide operating ambient temperature range of -40˚C to +70˚C
- Output voltage adjustability
- Primary-side controlled remote on/off
- Constant switching frequency
- Continuous short circuit protection
- Tracking
- Output overvoltage protection
- Input undervoltage and overvoltage protection

3. General Description

Electrical Description

The EXB30 Dual power module is a DC/DC converter that operates over an input voltage range of 18 to 36VDC for 24V models and 36 to 75VDC for 48V models and provides an isolated regulated DC output. The modules have maximum power ratings of 30W and excellent efficiencies are achieved by optimum driving of the synchronous rectification stage. The standard feature set includes remote on/off, tracking and output trim for maximum flexibility in distributed power applications.

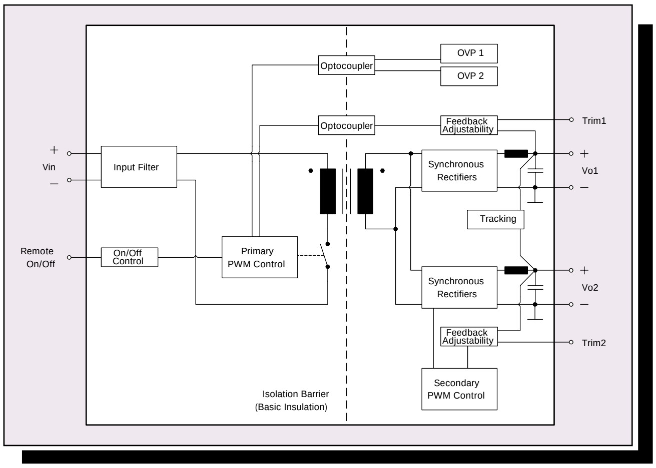


Figure 1 - Block Diagram of the EXB30 Dual

A block diagram of the EXB30 Dual converter is shown in Figure 1. The basic topology is an isolated forward converter. High efficiency is achieved through the use of synchronous rectification in both outputs, as well as planar magnetic components.

Two tightly regulated positive outputs are provided. Grounds of the outputs are connected internally (i.e. Vo1- is connected to Vo2-). Both outputs are independently trimmable. Output Vo1 is sensed and compared to a secondary side reference voltage. An error signal is transferred to the primary side via an optocoupler. The duty cycle is adjusted accordingly by the primary PWM controller. Output voltage Vo2 is sensed, compared and regulated in the secondary side using phase modulation control.

The internal second order input filter (LC) smoothes the input current and reduces conducted and radiated EMI. Further improvement can be achieved through the use of an optional external input filter.

The primary side remote on/off function allows the user to disable the converter, hence forcing the unit into a lower power dissipation mode.

At start-up a tracking circuit guarantees that the voltage differential between the outputs does not exceed safe limits.

Both outputs are independently monitored for overvoltages. If an overvoltage is detected on any of the outputs a signal is transmitted to the primary via an optocoupler. It is user-selectable whether the OVP event will lead to a latching or non-latching shutdown of the converter.

The power transformer which is a planar construction uses the PCB for the primary winding while SMT copper windings are used for the secondary winding. 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 output synchronous rectifiers are controlled by proprietary circuitry on the secondary side which optimise the driving scheme.

Physical Construction

The EXB30 Dual series are 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 optimise 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 involved.
- **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.

A separate paper discussing the benefits of 'open frame low to medium DC/DC converters' Design Note 102 is available from Artesyn Technologies. The effective elimination of potting and a case has been made possible by the use of modern automated manufacturing techniques and in particular the 100% use of SMT components, the use of planar magnetics and the exceptionally high efficiencies.

4. Features and Functions

Wide Operating Temperature Range

The wide ambient temperature range of the EXB30 Dual module is a consequence of the extremely high efficiency achieved and consequent low power dissipation. Operation from -40˚C to a maximum ambient temperature of +70˚C is achieved without the requirement for heatsinks or forced air cooling, making the EXB30 Dual series ideally suited to cost and space sensitive applications.

Output Voltage Adjustment

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

Remote On/Off
The Remote On/Off function allows the unit to be controlled by an external signal which puts the module into a low power dissipating sleep mode. Methods of using this function are given in the applications section. The Remote On/Off control pin also functions as a programming pin, to disable the overvoltage protection latch feature, described below.

Constant Switching Frequency
The switching frequency for all models is fixed at approximately 280kHz 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.

Current Limit and Short Circuit
All models of the EXB30 Dual series have a built in current limit function and continuous short circuit protection. Both the specified maximum output current and the current limit interception point refer to the sum of the output currents (i.e. Io1 + Io2). The current limit interception point is dependent on the input voltage, ambient temperature, and parametric spread. Hitting the current limit interception point causes the unit to enter a low-frequency hiccup mode.

If the sum of the output currents exceed the rating (i.e. Io1 + Io2 ≥6A) the converter is operated in overload mode. None of the specifications are guaranteed when in overload mode. While transient overload operation is acceptable (e.g. start-up into capacitive loads), permanent overload operation is not. In the latter case lifetime of the unit will be reduced, and the unit may suffer permanent damage in case thermal hotspot temperatures exceed the specified limits (see section Optimum Thermal Performance).

In short circuit operation the unit enters a low-frequency hiccup mode. A short circuit is defined as a resistance of 100mΩ or less. The RMS value of the pulsating output current in short circuit operation is limited to 8A simplifying the design of external crowbar circuits. While the unit is specified to operate into a continuous short circuit, frequent short circuits will reduce the lifetime of the converter.

Tracking
The EXB30 Dual converters feature output voltage tracking during start-up to protect the users circuitry. Tracking means that the voltage differential between the outputs during start-up is limited to a safe value preventing potential latch-ups in the users circuitry. As an example the turn-on behaviour of an EXB30-24D05-3V3 is shown in Figure 2.

The tracking voltage differential during start-up is defined as ΔV = Vo1-Vo2 and is limited to a maximum value of 0.7V up until output voltage Vo1 reaches the total error band of output voltage Vo2.

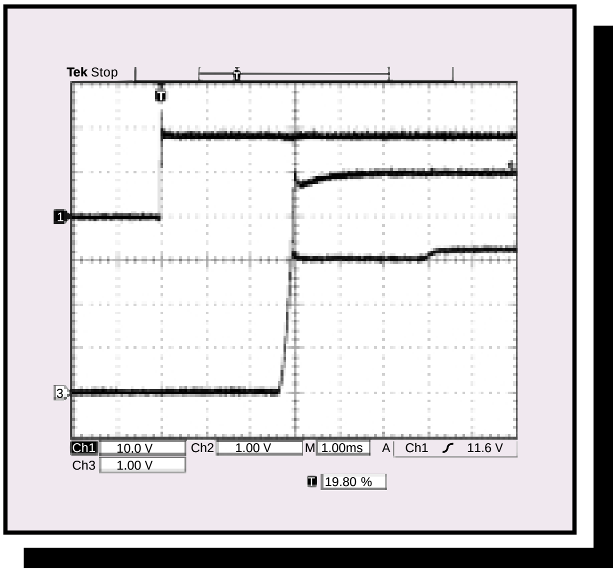


Figure 2 - Typical Output Voltage Tracking During Start-up (EXB30-24D05-3V3)
(Ch1 : Vin, Ch2 : Vo1, Ch3 : Vo2)

Note that the voltage setpoint of the tracking circuit is around 6% below the setpoint of the nominal voltage for output voltage Vo2. This is to ensure that the tracking circuit is off during normal operation. After a short delay the voltage control circuitry takes over from the tracking circuit and brings the output voltage Vo2 to its final nominal value.

Overtemperature Protection
The EXB30 Dual series does not provide overtemperature protection. Overstressing the converter by exceeding its maximum output power or maximum output current may lead to permanent damage. Special attention should be paid not to exceed specified temperature limits for given hotspot check points (see section Optimum Thermal Performance).

Output Overvoltage Protection
Both outputs are monitored for overvoltages to protect the users circuitry from damage should the converter fail.

OVP trip points are set at 125% of the nominal output voltage level for each output. Response time to an OVP event is typically around 2ms. If an OVP event is detected the converter will be shut down. If the OVP latches are enabled the converter will remain shut down until the input voltage is removed, and applied again. Alternatively the converter can be re-enabled by activating the remote on/off pin. If the OVP latches are disabled by the user the converter will shut down after an OVP event, but will try to restart automatically after 200ms. If the cause for the OVP event persists, the converter will periodically shut down, and try to restart.

Latching OVP is the default mode. The OVP latches can be disabled simply by connecting a resistor from the remote on/off pin to Vin+ as shown in Figure 3. Recommended resistor values are 47kΩ (24V models) and 100kΩ (48V models). Alternatively, the OVP latches can be disabled by actively pulling high the remote on/off pin.

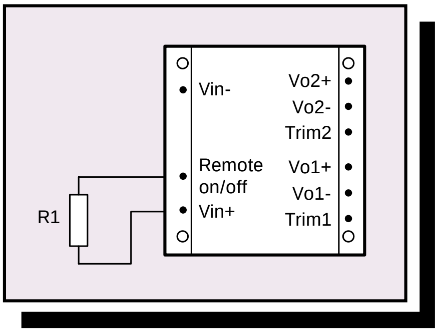


Figure 3 - Circuit to Disable OVP Latches using a Resistor

Note that the converter does not provide clamp devices (e.g. TVS) across the outputs. This means that the converter will detect overvoltages present at the outputs, but it cannot clamp them. Users may want to clamp overvoltages by external circuits (e.g. TVS, crowbars).

Input Undervoltage and Overvoltage Protection

The EXB30 Dual series is fitted with a detection circuit at the input side which inhibits operation of the converter when the input voltage is outside the normal operating range. For 48V models, 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

Isolation

The EXB30 Dual series has been submitted to independent safety agencies and has EN60950 and UL1950 Safety approvals. Basic insulation is provided and the unit is approved for use between the classes of circuits listed in Table 2.

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 2 - Insulation Categories for Basic

The TNV or Telecommunication Voltage definitions are given in Table V.1 of IEC950 from which EN60950 and UL1950 are derived.

The EXB30 Dual has an approved insulation system that satisfies the requirements of the safety standards.

In order for the user to maintain the insulation requirements of these safety standards it is necessary for the required creepage and clearance distances to be maintained between the input and output.

Creepage is the distance along a surface such as a PCB and for the EXB30 the creepage requirement between primary and secondary is 1.4mm or 55 thou. Clearance is the distance through air and the requirement is 0.7mm or 27 thou.

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 2A HRC (High Rupture Capacity) is the recommended fuse rating for the EXB30-48DXXX models. A 3.5A HRC (High Rupture Capacity) is the recommended fuse rating for the EXB30-24DXXX models.

6. EMC

The EXB30 Dual series 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. Following is the list of standards which apply and which it has complied with.

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 to do as the standard calls for 1m leads to be attached to the input and output ports and aligned such as 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’. In addition ETS 300 386-1 states that the testing should be carried out on the enclosure. The EXB30 Dual is primarily intended for PCB mounting in Telecommunication Rack systems.

For the purpose of the radiated test an EXB30-48D05-3V3 was mounted on a test PCB (230 x 170mm). A resistive load was connected by lead lengths of approximately 10cm and the lead length to the power source was 50cm. maximum balanced load is drawn (i.e. Io1 = Io2 = 3A). No enclosure was used. Typical radiated emission results are presented in Figure 4. An independent test house performed the testing and a copy of the report is available on request.

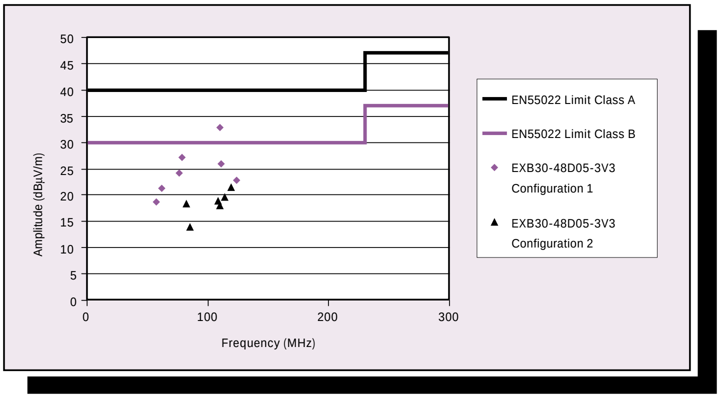


Figure 4 - Typical Radiated Emission EXB30-48D05-3V3 (Vin = 48V, Io1 = 3A, Io2 = 3A)

In configuration 1 the EXB30-48D05-3V3 was mounted on the testboard. It can be seen the unit comfortably meets level A.

In configuration 2 the ground plane of the testboard is connected to Vin-. In addition to that, the recommended external input filter B (See Figure 6) is used. In this configuration level B is met.

Conducted emissions

The applicable standard for conducted emission is EN55022 (FCC Part 15). The EXB30 Dual has a substantial LC filter on board to enable it to meet this standard with simple external filters. External filters for meeting both Class A and Class B limits are shown in Figures 5 to 7 and summarised in Table 3.

Model	Class A Filter Type	Class B Filter Type
EXB30-48D05-3V3	A	B
EXB30-48D3V3-2V5	A	B
EXB30-24D05-3V3 (1)	C	C
EXB30-24D3V3-2V5	C	C

Table 3 - External Input Filter Cross-Reference

Note 1: Model EXB30-24D05-3V3 requires an additional 22µF low-ESR capacitor across terminals Vin+ and Vin- for input impedance stabilisation.

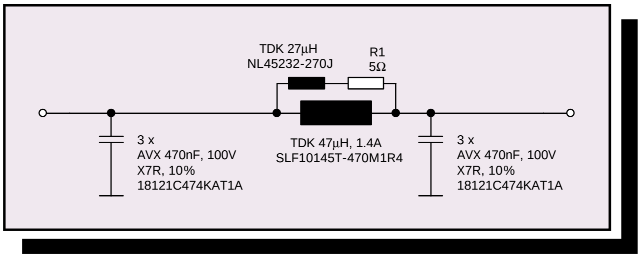


Figure 5 - External Filter A

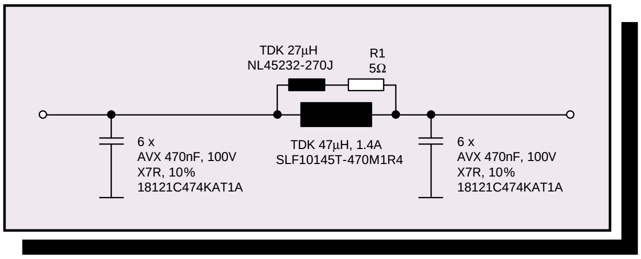


Figure 6 - External Filter B

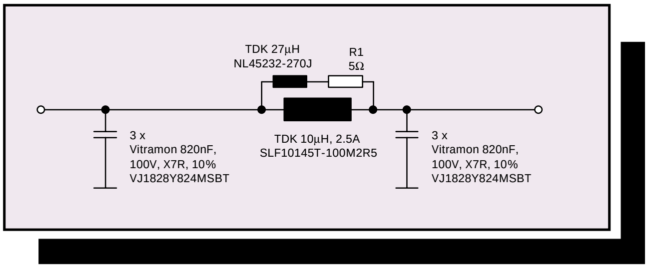


Figure 7 - External Filter C

Typical conducted emissions of the EXB30 Dual models using the recommended external input filters are shown in Figures 8 to 11.

Common Mode Noise

This is generated in switching converters and can contribute to both radiated emissions and input conducted emissions. The EXB30 Dual series of converters bypasses common mode noise internally by using a 2.2nF capacitor between input ground and output ground. The EXB30 Dual series will therefore greatly minimise common mode noise currents flowing in the application circuitry.

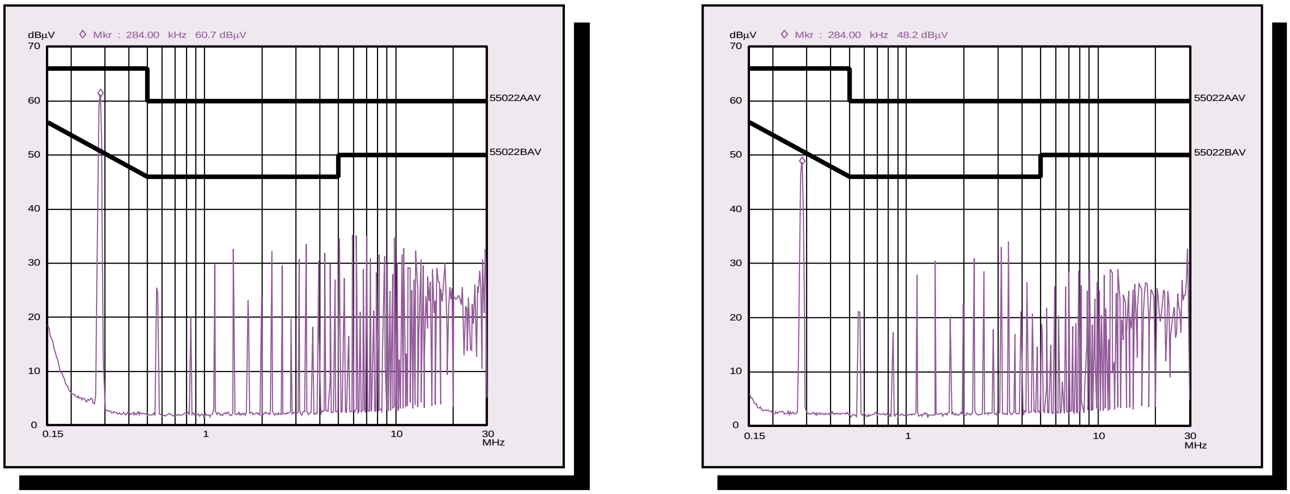


Figure 8 - Typical Spectrum EXB30-48D05-3V3 (Vin = 75V, Io1 = 6A, Io2 = 0A) 50µH LISN.
Class A/B Average Limit Lines Shown. (Left: Using External Filter A. Right: Using External Filter B)

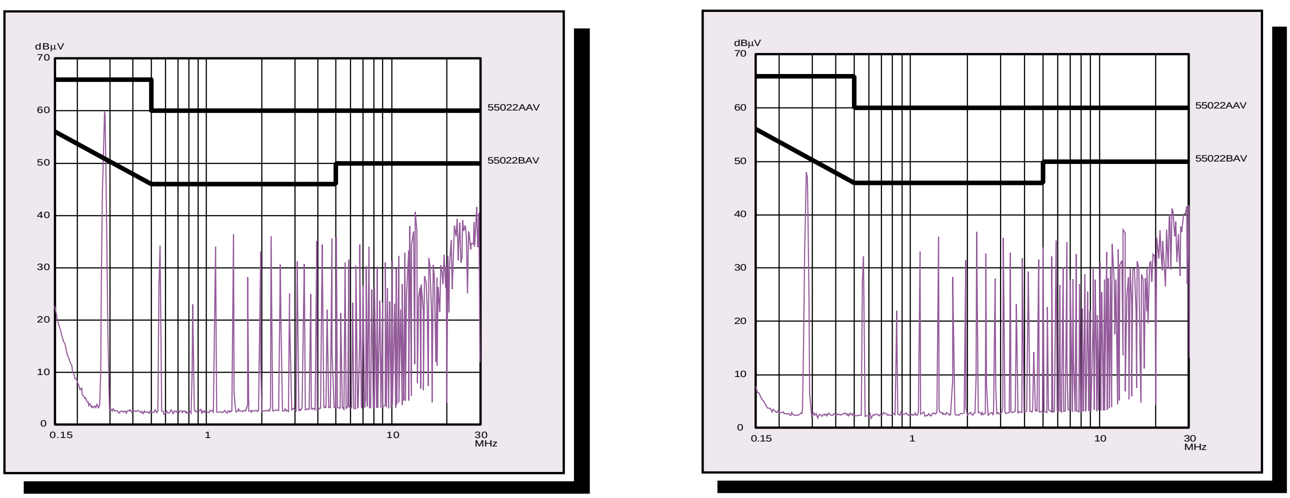


Figure 9 - Typical Spectrum EXB30-48D3V3-2V5 (Vin = 75V, Io1 = 6A, Io2 = 0A) 50µH LISN.
Class A/B Average Limit Lines Shown. (Left: Using External Filter A. Right: Using External Filter B)

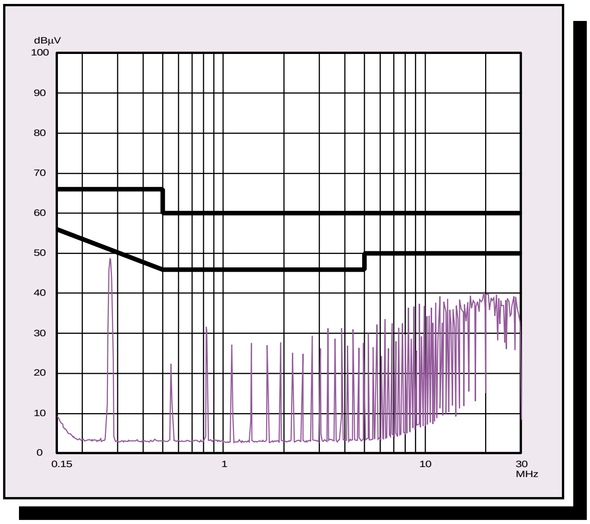


Figure 10 - Typical Spectrum EXB30-24D05-3V3
(Vin = 24V, Io1 = 6A, Io2 = 0A) 50µH LISN.
Class A/B Average Limit Lines Shown. (Using External Filter C)

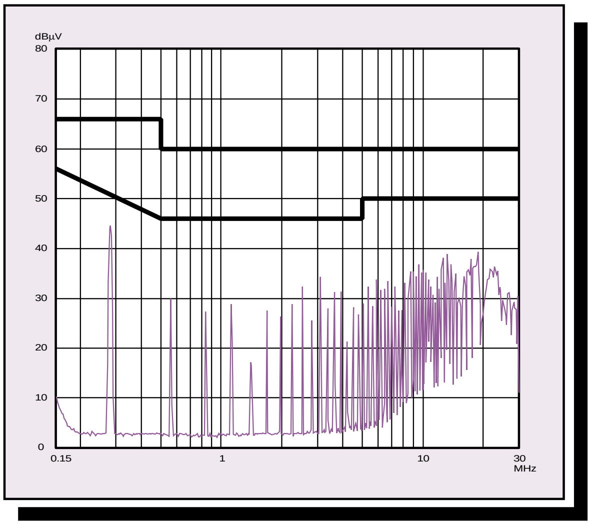


Figure 11 - Typical Spectrum EXB30-24D3V3-2V5
(Vin = 24V, Io1 = 6A, Io2 = 0A) 50µH LISN.
Class A/B Average Limit Lines Shown. (Using External Filter C)

7. Use in a Manufacturing Environment

Resistance to Soldering Heat
The EXB30 Dual series are 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 with the recommended PCB layout pattern shown in the applications section. 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 4.

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

Table 4 - Wave Solder Test Conditions

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

Water Washing
The EXB30 Dual 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

ESD Control
The EXB30 Dual 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 an approved ESD control procedures. Failure to do so could affect the lifetime of the converter.

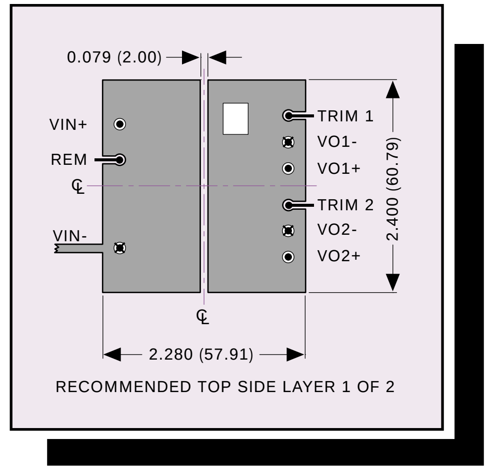


Figure 12 - Recommended Top Side (Layer 1 of 2)

FOR THERMAL RELIEF IN CONDUCTOR PLANES
REFERENCE IPC-D-275 SECTION 5.3.2.3

ALL DIMENSIONS IN INCHES (mm)
ALL TOLERANCES ARE ±0.10 (0.004)

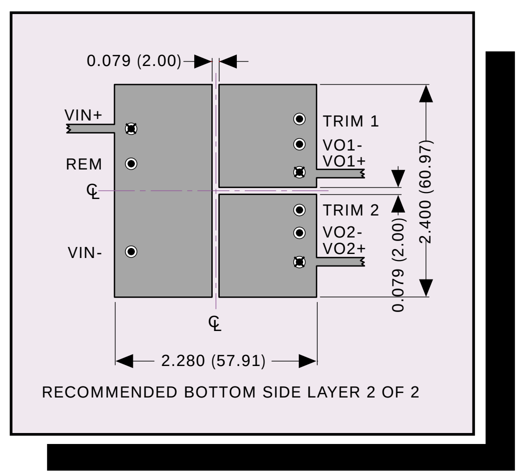


Figure 13 - Recommended Bottom Side (Layer 2 of 2)

8. Applications

Optimum PCB Layout
A recommended PCB layout for a two-layer board can be found below. Although internally joined together it is recommended to have a common secondary ground plane connecting Vo1- and Vo2-. This will result in improved efficiency and reduced radiated noise.

For compliance with safety regulations there are three keep-out areas on the top side of the user board. The primary core area is a keep-out area for secondary-side tracks and vias. The secondary inductor area is a keep-out-area for primary-side tracks and vias. The optocoupler area is a keep-out area for both primary and secondary-side tracks and vias.

VIEW IS FROM TOP SIDE

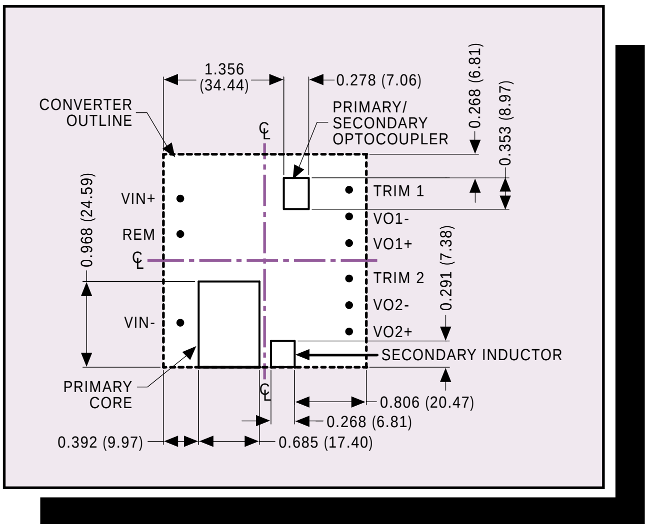


Figure 14 - Keep Out Areas for Top Side of User Board

FOR THERMAL RELIEF IN CONDUCTOR PLANES
REFERENCE IPC-D-275 SECTION 5.3.2.3

ALL DIMENSIONS IN INCHES (mm)
ALL TOLERANCES ARE ±0.10 (0.004)

Optimum Thermal Performance

All EXB30 Dual models can typically deliver full power in still air up to a maximum ambient temperature of 70˚C using the recommended PCB layout shown in the previous section. Still air which is sometimes called natural convection is defined as 0.1m/s airflow. Above 70˚C the output power may be derated so that the maximum ambient operating temperature can be extended to 100˚C as shown in Figure 15.

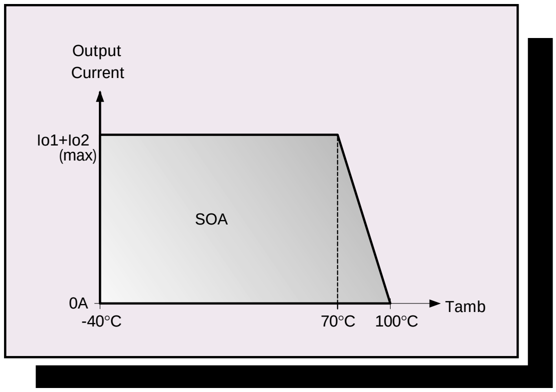


Figure 15 - Typical Output Current Safe Operating Area vs Ambient Temperature (Natural Convection)

If forced air cooling is used then the converter can provide full output power up to higher ambient temperatures (e.g. up to 95˚C at an airflow of 2m/s) before derating.

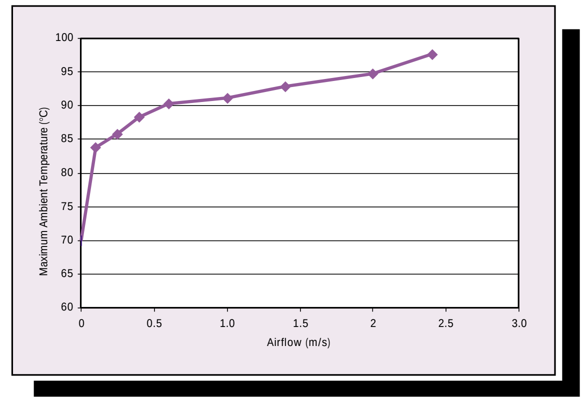


Figure 16 - Typical Maximum Ambient Temperature at Full Power vs Air Velocity

In a complex thermal set-up of an arbitrary system the definition of ambient temperature can be ambiguous. The local ambient temperature seen by the converter may be considerably higher than the system ambient temperature. Therefore, in any case it should be verified that the hotspot temperatures of the converter are within specification. The hotspot check points are shown in Figure 17.

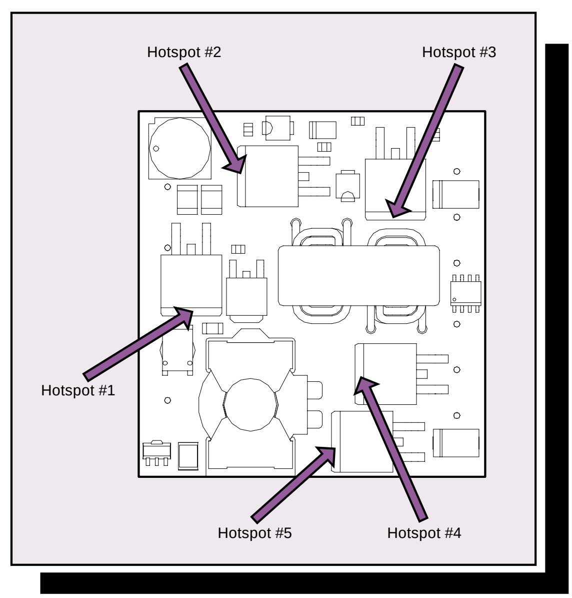


Figure 17 - Hot Spot Temperature Check Points
(Measure at Tabs of D²Paks. Beware: Tabs are at High Potential!)

There are five hotspot check points on the EXB30 Dual. The hottest is dependent on the input line voltage, the output load combination, and the local ambient temperature of the converter. Typically the hotspot temperatures will be within 10˚C of each other. When measuring the temperatures of these points the thermocouple should be mounted as closely as possible to the tab of the device. In order to maintain the stringent Artesyn Derating Criteria none of the temperatures should exceed 120˚C.

Remote On/Off Control
The remote on/off control feature allows 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 which allows the converter to be put in a low dissipating sleep mode.

The EXB30 models are available in a positive logic remote on/off configuration. The control pin is held high through an internal resistor.

High-active units of the EXB30 Dual series are turned on if the remote on/off pin is high or floating. Pulling the pin low will turn off the unit. The signal level of the remote on/off pin is defined with respect to Vin-.

In addition to on/off control, the remote on/off pin also serves as an input for enabling or disabling the OVP latch (see section Overvoltage Protection). Note that if the remote on/off pin is actively pulled high, the OVP latch will be disabled. If OVP latching is required, it is recommended to drive the remote on/off pin with open collector logic.

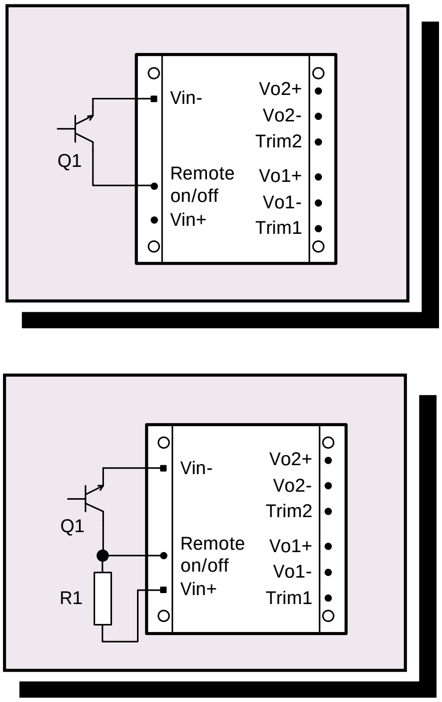


Figure 18 - Implementation of Remote On/Off with a Single Transistor (Top: OVP Latch Enabled. Bottom: OVP Latch Disabled)

The converter has a built-in three-state detection circuit supporting remote on/off control of the converter through a single external transistor as shown in Figure 3. Without an external pull-up resistor R1 the maximum voltage stress of Q1 is 7V. If an external pull-up resistor R1 is used, the voltage stress for Q1 is equal to the input voltage. If pulled to Vin- the current flowing out of the remote on/off pin is limited to 100µA max.

Specification for the Remote On/Off
See signal electrical interface on the EXB30 Dual data sheets.

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 Vi(-), this can be a device such as a mechanical switch, open collector transistor or opto-isolator.

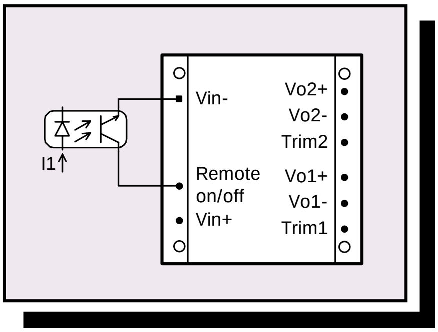


Figure 19 - Isolated Closure using an Optocoupler

Note in the data sheet, the 'acceptable high level leakage current'. 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).

Output Voltage Adjustment

Output voltages of the two outputs can be independently adjusted using resistors. One trim per output is provided. Connecting a resistor between the trim pin and the positive output will trim down the unit. A resistor between the trim pin and the negative output will trim up the unit. This is shown in Figures 20 to 25.

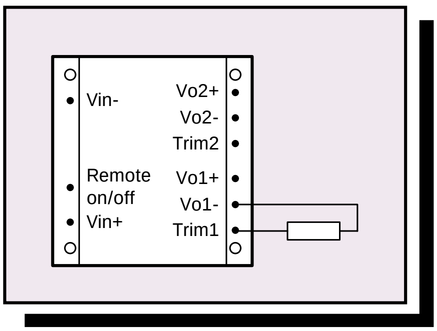


Figure 20 - Trimming Output Voltage Vo1 (Trim Up)

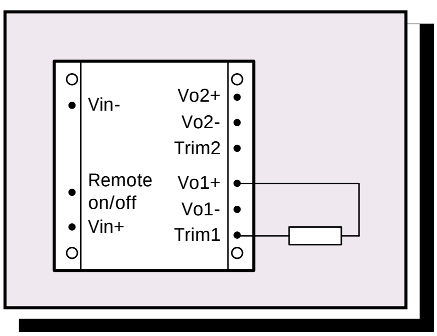


Figure 21 - Trimming Output Voltage Vo1 (Trim Down)

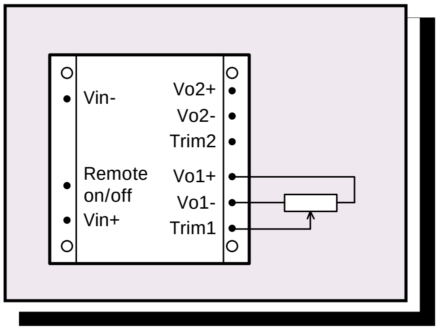


Figure 22 - Trimming Output Voltage Vo1 (Variable Trim)

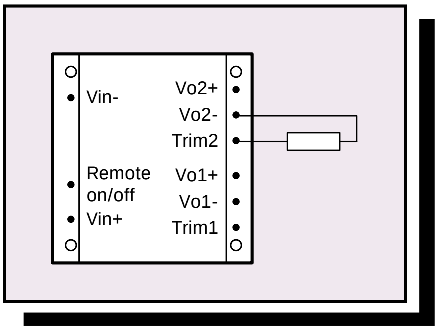


Figure 23 - Trimming Output Voltage Vo2 (Trim Up)

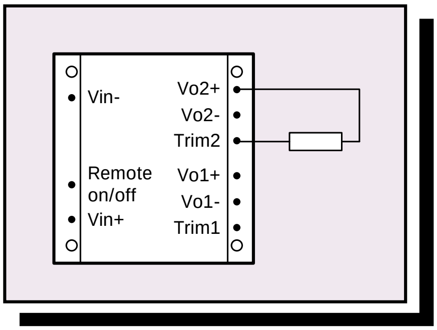


Figure 24 - Trimming Output Voltage Vo2 (Trim Down)

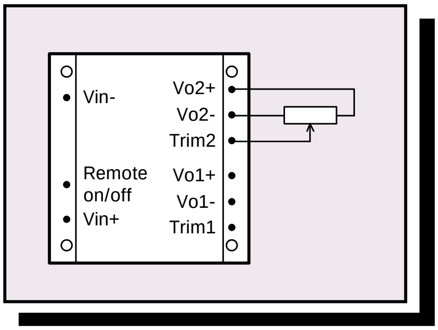


Figure 25 - Trimming Output Voltage Vo2 (Variable Trim)

The trim function has a minimum range of ±10%. Trim curves for the various outputs can be found in Appendix 1. Alternatively, equations given in Table 5 can be used to determine trim resistor values.

MODEL	Trim Down Resistor KΩ	Trim Up Resistor KΩ
5.0V	$\frac{1.118 \cdot Vo - 2.796}{-0.4444 \cdot Vo + 2.222} - 8.2$	$\frac{0.118 \cdot Vo - 2.796}{-0.4444 \cdot Vo + 2.222} - 8.2$
3.3V	$\frac{Vo - 1.457}{-0.5618 \cdot Vo + 1.854} - 6.8$	$\frac{1.457}{0.5618 \cdot Vo - 1.854} - 6.8$
2.5V	$\frac{1.095 \cdot Vo - 1.358}{-0.8717 \cdot Vo + 2.178} - 4.3$	$\frac{0.095 \cdot Vo - 1.358}{-0.8717 \cdot Vo + 2.178} - 4.3$

Table 5 - Equations for Trim Resistor Values

Output Capacitance

The maximum load capacitance of the EXB30 Dual converters is 2000µF per output. For larger capacitances than this please contact your local Artesyn Technologies representative.

Parallel and Series Operation

Because of the absence of an active current sharing feature, parallel operation of multiple EXB30 Dual converters is generally not recommended. If unavoidable, Oring-diodes have to 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.

In theory outputs of multiple EXB30 Dual converters can be connected in series. Please note, however, that the two outputs of an individual EXB30 Dual converter are not isolated from each other, but have their grounds connected internally (i.e. Vo1- is connected to Vo2-).

Output Noise and Ripple Measurement

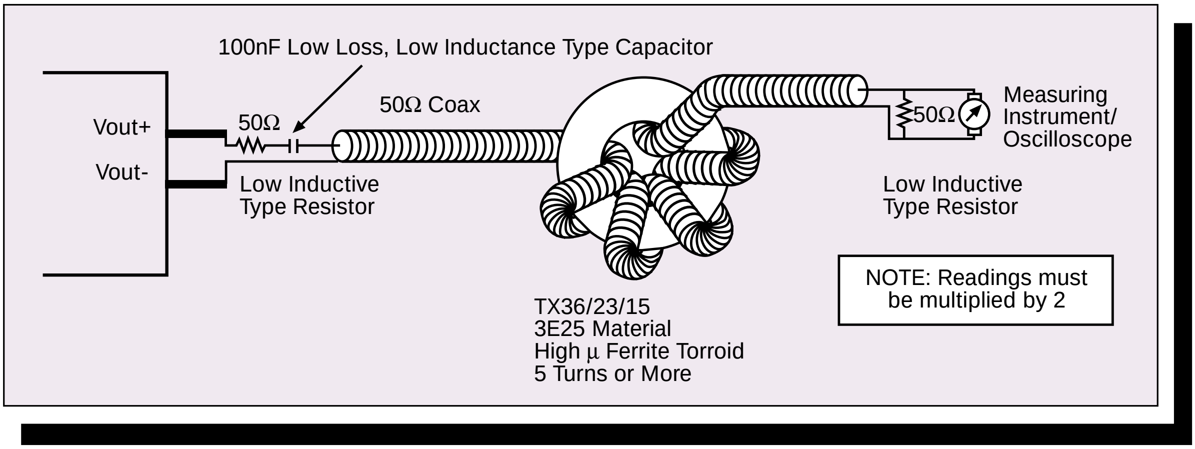


Figure 26 - Output Noise and Ripple Set-up

The above circuit has been used for noise measurement on EXB30 Dual series converters. The large toroid will act as a common mode filter to noise which would otherwise flow through the measuring instrument or oscilloscope to disturb the measurement of the differential mode noise.

A 50Ω coax lead should be used with source and termination impedances of 50Ω. This will prevent impedance mismatch reflections which would otherwise disturb the noise reading at higher frequencies.

The 50Ω resistor which is added in series with the output of the power supply will form a voltage divider with the termination 50Ω and so ripple and noise measurement readings should be multiplied by 2.

Compatibility with LT®1640L Hot Swap Controller

To allow safe board insertion and removal from a live backplane the inrush current should be limited. A recommended inrush current circuit is shown in Figure 27. The circuit provides a programmable inrush current limit and a programmable electronic circuit breaker. Please refer to the datasheet of the LT1640L[1] for detailed information.

The EXB30 comes with its own internal UV lockout feature. Therefore components R4, R5, R6, R7, R8 and Q2 are required only if the UV thresholds of the EXB30 Dual is to be increased, or additional overvoltage protection is required. Typically these components can be eliminated (except R8, which might be required for disabling the OVP latches as previously discussed).

Circuit block XF1 consists of the recommended input filter (see section Conducted Emissions), hold-up and input impedance stabilising capacitors.

Recommended values for R7 are 200k (48V systems) and 100k (24V systems). R8 is required only if the OVP latch is to be disabled (see section Overvoltage Protection).

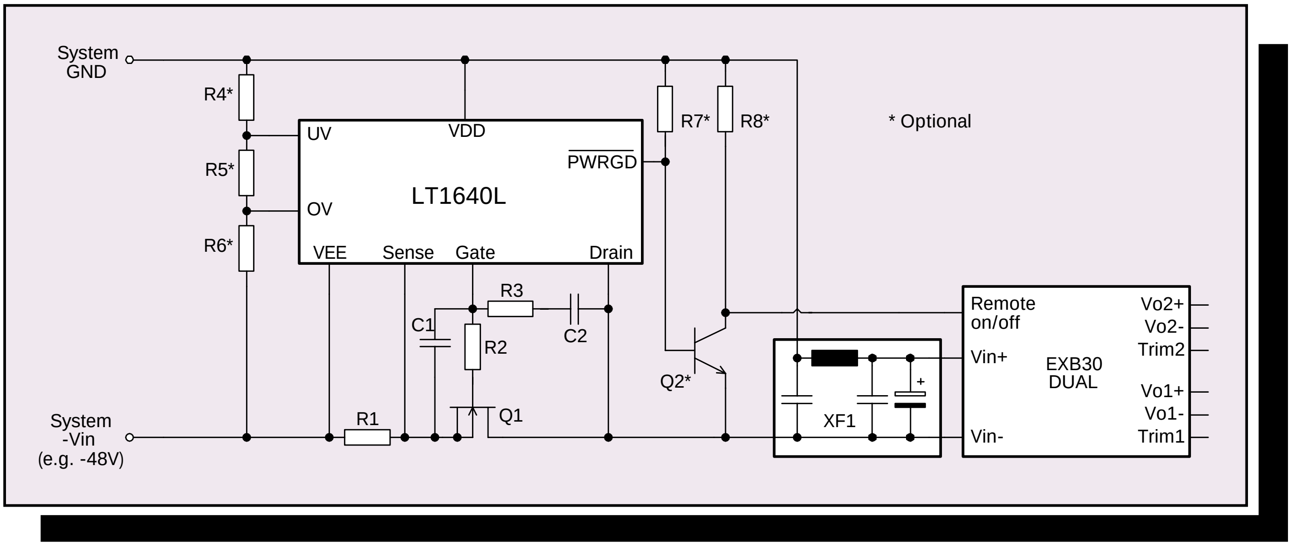


Figure 27 - LT1640H Hot Swap Controller Interface with EXB30-48SXXX

[1] Datasheet 'LT1640L Negative Voltage Hot Swap Controller' available from Linear Technology Corporation.

9. Appendix 1
Typical trim curves

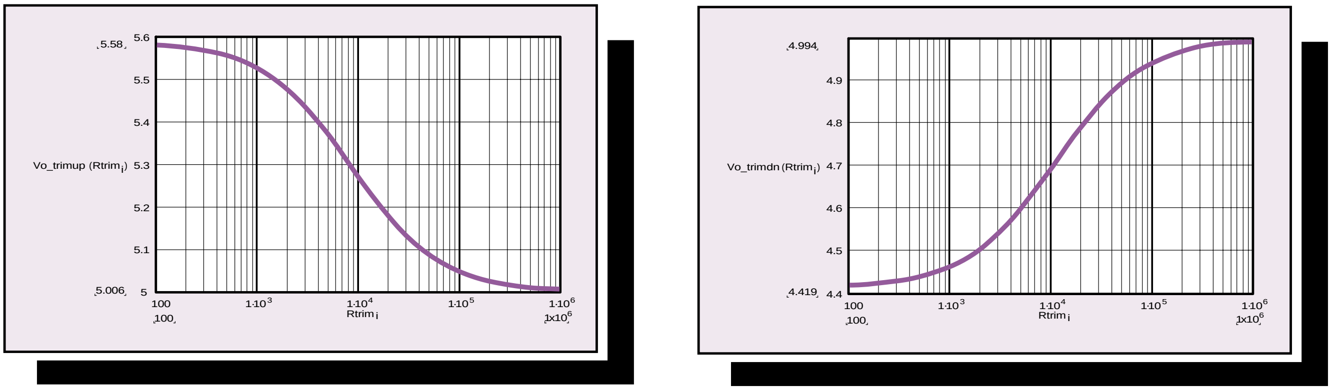


Figure 28 - Typical Trim Curves for 5V Outputs. Output Voltage vs Trim Resistor Value
(Left: Trim Up. Right: Trim Down)

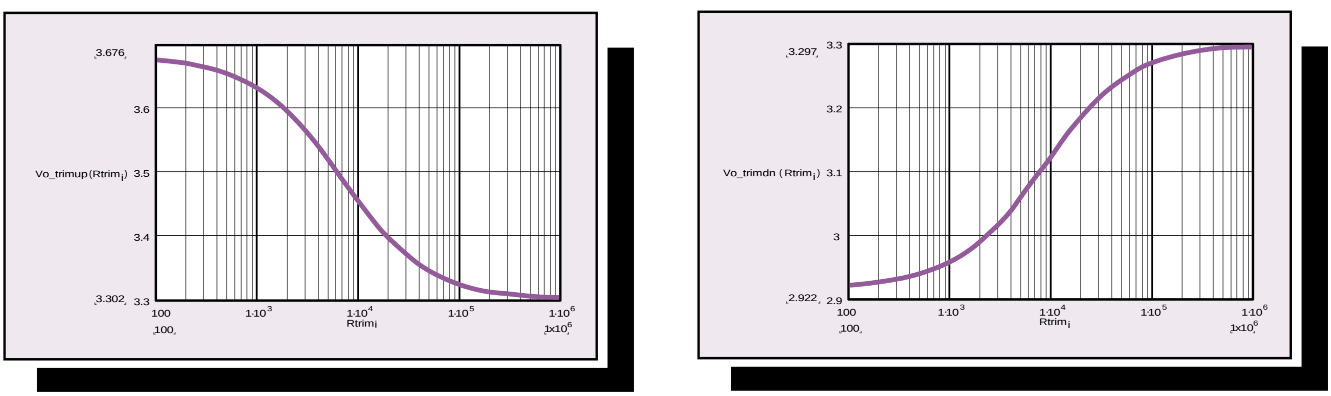


Figure 29 - Typical Trim Curves for 3.3V Outputs. Output Voltage vs Trim Resistor Value
(Left: Trim Up. Right: Trim Down)

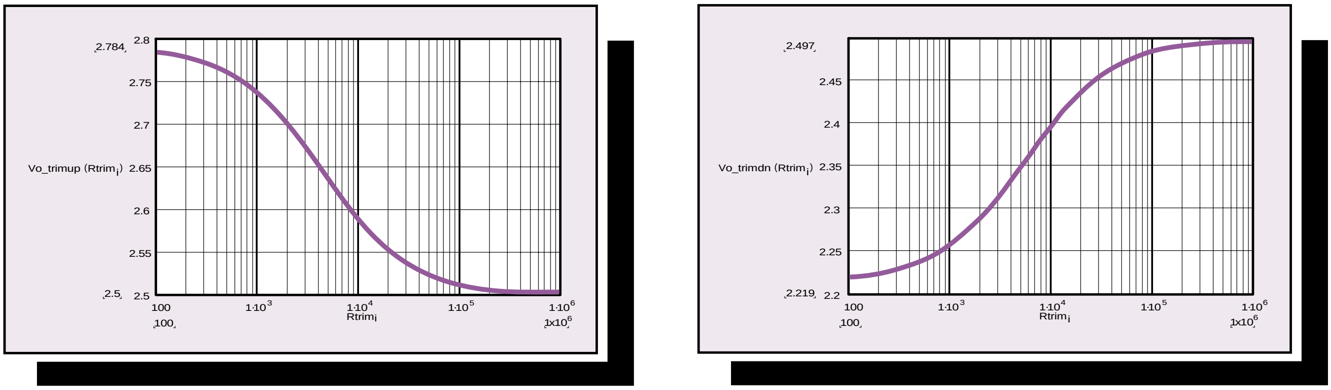


Figure 30 - Typical Trim Curves for 2.5V Outputs. Output Voltage vs Trim Resistor Value
(Left: Trim Up. Right: Trim Down)