20W DC/DC **ESB** CONVERTER SERIES

Absolute Maximum Rating

The absolute maximum ratings indicate limits beyond which damage to the device may occur.

Input supply voltage (voltage range 9-36V, 18-36 model) --- 40VDC
Input supply voltage (voltage range 18-75V, 36-75 model) - 80VDC
Enable input voltage(referenced to –input pin ---------- 7VDC
Lead temperature(Soldering, 10 seconds) ---------- 300℃
Power dissipation ---------- Internally Limited

Removal of Soldered DC/DC Modules from PCB's

Should removal of the ESB or ESC(Abb. ESB/C) module from its soldered connection be needed, it is very important to thoroughly de-solder the pins using solder wicks or de-soldering tools. At no time should any prying or leverage be used to remove boards that have not been properly de-soldered first.

Input and Output Impedance

ESB/C converters have been designed to be stable with no external capacitors when used in low ac-impedance input and output circuits. The DC/DC's performance and stability can be compromised by the use of highly inductive source impedances. The input circuit shown in Figure 1 is a practical solution that can be used to minimize the effects of inductance in the input traces. For optimum performance, components should be mounted close to the DC/DC converter.

I/O filtering, Input Ripple Current, and Output Noise

All models in the ESB/C series are tested/specified for input ripple current (also called input reflected ripple current) and output noise using the circuits and layout shown in Figures 1 and 2.

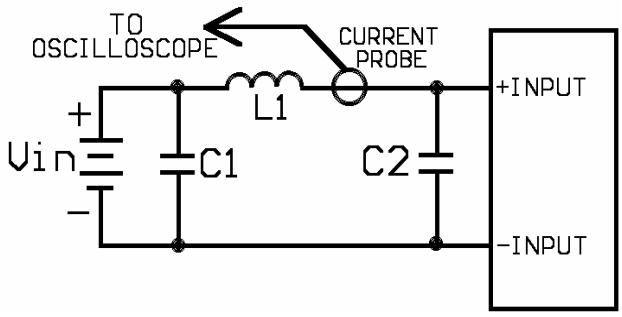

Figure 1. Measuring input Ripple Current

External input capacitors (C2) serve basically as energy-storage elements; they should be selected for bulk capacitance (at appropriate frequencies), low ESR, and high RMS ripple current ratings. The switching nature of DC/DC converters requires that DC voltage sources gave low AC impedance because highly inductive source impedance can affect system stability. In Figure 1, C1 and L1 simulate a typical DC BUS.

In critical application, output ripple/noise can be reduced below specified limits using filtering techniques, the simplest of which is the installation of additional external output capacitors. Output capacitors function as true filter elements and should be selected for bulk capacitance, low ESR, and appropriate frequency response.

In Figure 2, the two copper strips simulate real-world PCB impedances between the converter and its load. Scope measurements should be made using BNC connectors or the probe ground should be less than 1/2 inch and soldered directly to the fixture.

All external capacitors should have appropriate voltage ratings and be located as close to the converter as possible. Temperature variations for all relevant parameters should be taken into consideration.

The most effective combination of external I/O capacitors will be a function of line voltage and source impedance, as well as particular load and layout conditions.

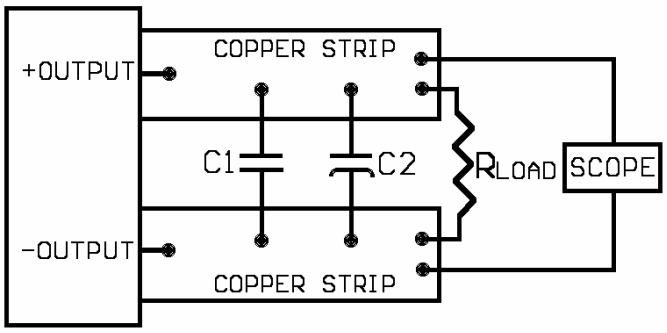

Figure 2. Measuring Output Ripple/Noise

Start-up Threshold and Under Voltage Luck Off

Under normal start-up conditions, ESB/C Series will not begin to start until the ramping input voltage exceeds the Start-up Threshold. Once operating, devices will turn off when the applied voltage drops below the Under Voltage Luck Off point. Devices will remain off as long as the under voltage condition continues. Units will automatically re-start when the applied voltage is brought back above the Start-up Threshold. The hysteretic built into this function avoids an indeterminate on/off condition at a single input voltage. See **Electrical Specifications** table for actual limits.

Start-Up Time

There are two Start-Up Times. The first, Input to Output Start-Up Time is the interval between the point at which a ramping input voltage crosses the Start-Up Threshold voltage and the point at which the fully loaded output voltage enters and remains within it specified ±1% accuracy band. Actual measured times will vary with input source impedance, external input capacitance, and the slew rate and final value of the input voltage as it appears to the converter. The second, Enable to Output Start-Up Time assumes the converter is turned off via the Enable control with the nominal input voltage already applied. The specification defines the interval between the point at which the converter is turned on and the point at which the fully loaded output voltage enters and remains within its specified ±1% accuracy band.

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Enable Control

The primary-side, Enable Control function can be specified to operate with either positive or negative polarity. Positive-polarity devices are enabled when the enable pin is left open or is pulled high (+3 to +7 VDC applied with respect to – input). Positive-polarity devices are disabled when the enable pin is pulled low (under +1.0V with respect to –input). Negative-polarity devices are off when the enable pin is high/open and on when the enable pin is pulled low. See Figure 3.

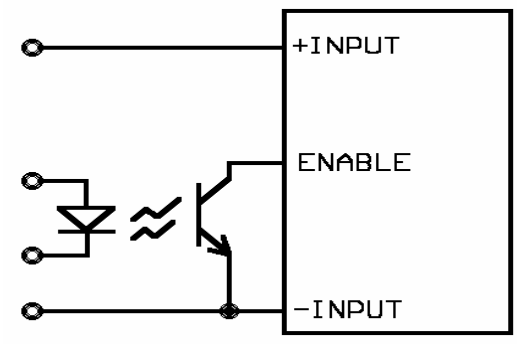

Figure 3. Driving the Enable Control pin

Dynamic control of the remote enable function is best accomplished with a mechanical relay or an open collector/ open drain drive circuit. The drive circuit should be able to sink appropriate current when activated and withstand appropriate voltage when deactivated.

Current Limiting

When power deliver of the converters higher than the rated power, the DC/DC converter will go into a current limiting mode. In this condition, output voltages will decrease proportionately with increases in output current, thereby maintaining somewhat constant power dissipation. This is commonly referred to as power limiting. Current limit inception is defined as the point where the full power output voltage falls below the specified tolerance. If the load current being drawn from the converter is significant enough, the unit will go into a shot circuit condition. See “Short Circuit Condition.

Short Circuit Condition

When a converter is in current limit mode the output voltages will drop as the output current demand continuously increases to excess the pre-setting point then controller will shut down the converter. Following a timeout period of 10 to 20 milliseconds. The converter will restart and build up the output voltages to their appropriate values. If the short circuit condition persists, another shutdown cycle will be initialed. This on/off cycling is referred to as “hiccup” mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The converter is capable of enduring an indefinite short circuit output condition. The hiccup protection function is applied on the ESC modules only.

Thermal Shutdown

ESC converters are equipped with thermal shutdown circuitry. If the internal temperature of the converter rises above the designed operating temperature, the OTP function will shut down the unit. When the internal temperature decreases below the threshold of the temperature setting, then the units will self-restart.

Output Over Voltage Protection

The output voltage is monitored by an OVP circuitry. If the output voltage rises to a fault condition (pre-setting value), which could be damaging to the load circuitry, then OVP circuitry will shut down the unit until the Input Voltage or Enable Input was recycled.

Output Voltage	1.5V	1.8V	2.5V	3.3V	5.0V	9V	12V	15V
OVP Trip Value	2.0V	2.3V	3.2V	4.2V	6.3V	12V	15V	18V

Input Reverse Polarity protection

If the input voltage polarity is accidentally reversed, an internal diode will become forward biased and likely draw excessive current from the power source. If the source is not current limited (<5A) nor the circuit appropriately fused, it could cause permanent damage to the converter.

Input Fusing

Certain applications and/or safely agencies may require the installation of fuses at the inputs of power conversion components. Fuses should also be used if the possibility of a sustained, non-current limited, input voltage polarity reversal exists, For ESB/C series DC/DC converters, slow blow fuses are recommended with values no greater than the following:

Output Power Rank	ESB/C24-Models/ ESB/C36-Models Fuse Value	ESB/C48-Models Fuse Value
10 W	1.0 Amps	0.5 Amps
15 W	2.0 Amps	1.0 Amps
20 W	2.5 Amps	1.5 Amps
25 W	3.0 Amps	1.5 Amps
35 W	4.0 Amps	2.0 Amps

Trimming Output Voltage – for Single output models

Only the single output converters have a trim function that allows users to adjust the output voltage from +10% to –10% (for ESB/C24- Modules and ESB/C48- Modeles) or from +5% to –5%(for ESB/C18- or ESB/C36- Modules), please refer to the trim table that follow for details. Adjustments to the output voltage can be used with a simple fixed resistor as shown in Figures 4 and 5. A single fixed resistor can increase or decrease the output voltage depending on its connection. Resistors should be located close to the converter. If the trim function is not used, leave the trim pin open.

Trim adjustments higher than the specified range can have an adverse affect on the converter’s performance and are not recommended. Excessive voltage differences between output voltage and sense voltage, in conjunction with trim adjustment of the output voltage; can cause the OVP circuitry to activate.

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Thermal de-rating is based on maximum output current and voltage at the converter's output pins. Use of the trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the converter's specified rating. Therefore: (V_{OUT} at pins) X (I_{OUT}) ≦ rated output power

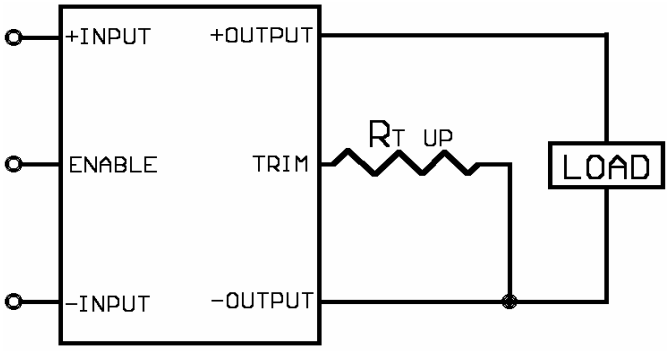

Figure 4. Trim Connections To Increase Output Voltages Using Fixed Resistors

	Trim up register value(KΩ)									
Vout	+1%	+2%	+3%	+4%	+5%	+6%	+7%	+8%	+9%	+10%
1.5VDC	4.47	1.9	1.13	0.74	0.5	0.35	0.24	0.15	0.84	0.34
1.8VDC	7.06	3.3	2.09	1.26	0.89	0.62	0.42	0.28	0.17	0.94
2.5VDC	56.85	25.9	15.4	10.5	7.2	5.16	3.76	2.67	1.84	1.17
3.3VDC	72.82	34.4	21.2	14.4	9.9	7.22	5.29	3.88	2.74	1.84
5VDC	109.7	51	31.2	20.3	14.2	9.87	7.1	5.0	3.38	2.08
9VDC	202	90	52	33.8	22.5	14.8	9.63	5.62	2.48	0
12VDC	270	120	70	45.2	30.1	19.8	12.8	7.52	3.31	0
15VDC	337	150	87	56.2	37.5	24.7	16	9.38	4.16	0

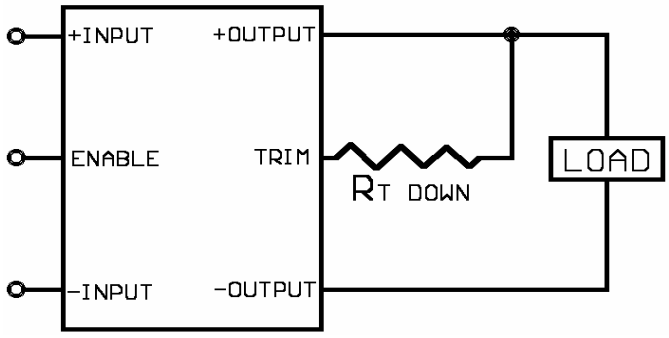

Figure 5. Trim Connections To Decrease Output Voltages Using Fixed Resistors

	Trim down register value(KΩ)									
Vout	-1%	-2%	-3%	-4%	-5%	-6%	-7%	-8%	-9%	-10%
1.5VDC	5.82	2.62	1.5	1.0	0.69	0.48	0.33	0.2	0.14	0
1.8VDC	15.6	6.9	4.2	2.9	2.0	1.56	1.22	0.94	0.73	0.55
2.5VDC	56.86	24.7	14.4	9.17	6.14	4.04	2.55	1.34	0.38	0.13
3.3VDC	101.3	36.2	20.95	13.65	9.2	6.0	4.12	2.56	1.34	0.87
5VDC	127.6	55.8	32.96	20.2	14.2	9.46	5.97	3.6	1.77	0.28
9VDC	202	90	52	33.8	22.5	14.8	9.63	5.62	2.48	0
12VDC	270	120	70	45.2	30.1	19.8	12.8	7.52	3.31	0
15VDC	337	150	87	56.2	37.5	24.7	16	9.38	4.16	0

Remote Sense

ESB/C series converters don't employ the sense feature.

Floating Outputs

Since these are isolated DC/DC converters, their outputs are "floating" with respect to their input. Designers will normally use the -Vout as the ground/return of the load circuit. You can, however, use the +Vout as ground return to effectively reverse the output polarity.

EMC Specifications

The conducted EMI measurement was performed using a ESB/C module placed directly on the test bench. All ESB/C series converters meet class B in EN 55022, CISP 22 and FCC part 15J without external Filter.

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