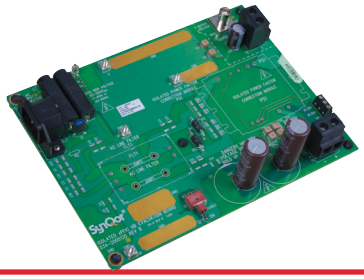
EVAL-1000042

Evaluation Board for the AeroQor Series of Isolated Power Factor Correction Converters



Summary

SynQor has developed the EVAL-1000042, an evaluation board to facilitate testing of our AeroQor isolated PFC converter and its associated AC EMI filter.

Introduction

This application note is a guide to the features, schematic, component placement, and Bill of Materials for this evaluation board. The applicable converter modules are:

Table 1: Applicable converter and filter modules

Product	Filter Module	Isolated Power Factor Correction Module
AeroQor	ACF-U-230-QM	APFIC-U-XX[R,D]-HM
AeroQor	ACF-U-230-QT	APFIC-U-XX[R,D]-HT

For assistance with testing the performance of our AC-DC power factor correction modules, please refer to our application note “Guidelines for Testing SynQor DC-DC Converters”.

Contents

This evaluation board and schematic are intended for demonstration purposes only and no guarantees are made for standards compliance

Shock Warning: There are areas of this evaluation board that have exposed access to hazardous high voltage levels. Exercise caution to avoid contact with those voltages. Also note that the evaluation board may retain high voltage temporarily after input power has been removed. Exercise caution when handling.

Thermal Considerations: When testing emi filters and converters on an evaluation board, ensure adequate cooling. Apply cooling air with a fan blowing across heatsink attached to the converter. Monitor the converter temperature to ensure it doesn’t exceed the maximum rated per the datasheet specification.

Sockets: Please note that this evaluation board uses sockets to provide the option of testing multiple converters. For longer-term testing, thermal testing, and permanent installations use soldered connections.

Section 1 – Converter Description

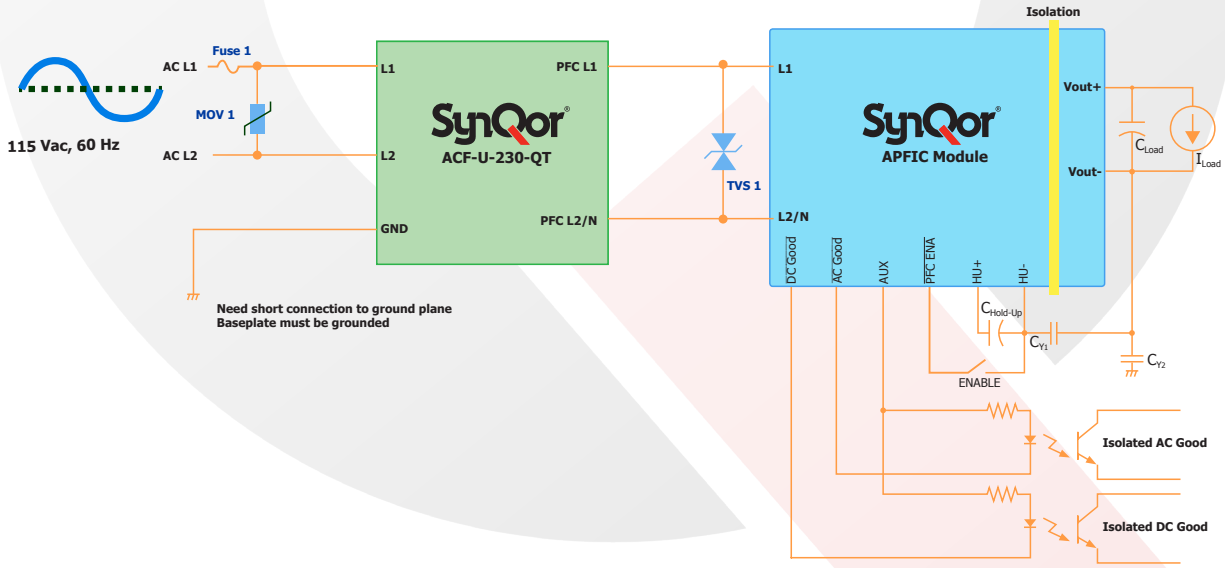
SynQor has developed two different isolated Power Factor Correction (PFC) modules to meet the specific Civil Aviation power requirements. All isolated PFCs are high power, high efficiency AC-DC converters. They operate from a universal AC input and generate an isolated and regulated output. The APFIC is designed to help meet Civil Aviation standards. Used in conjunction with a hold-up capacitor, SynQor's isolated PFCs and their respective AC line filters, draw a nearly perfect sinusoidal current (PF>0.99) from a single-phase AC input.

The hold-up capacitor has a typical voltage of 400 Vdc. The hold-up capacitor performs two functions:

1. It handles the cyclic imbalance between the flow of energy drawn from the AC source and the flow of energy delivered to the load. In doing so, the voltage across the hold-up capacitor has a ripple at a frequency twice that of the AC source voltage (e.g. 120 Hz for a 60 Hz input). The larger the hold-up capacitor, or the higher the frequency of the AC source, the smaller this ripple will be.
2. It provides a source of energy so that the APFIC can continue to deliver load power during a temporary brownout or dropout of the AC source. The larger the hold-up capacitor the longer it can provide this energy. Often it will be made large enough to allow the load to be gracefully shutdown after the AC source has been outside of its normal range for a set amount of time. A typical "hold-up time" would be in the 20 ms range for a 400 Hz system.

Section 2 – Evaluation Board Configuration

This EVAL-1000042 board is designed to facilitate the testing of our Isolated PFCs and their associated AC line filters. Because each of the three sectors have distinct requirements, the EVAL-1000042 is design to accommodate different components depending on the application. Figure 1 shows a typical connection diagram for a Civil Aviation application.



CY1-Y2:	See "EMI Considerations" in application notes
Fuse 1:	250VAC, 5A; Littelfuse 0216005.MXEP
MOV1:	300VAC, 60J; EPCOS S10K300E2
TVS1:	400V, 3J; two VISHAY 1.5KE200CA devices connected in series
CHold-Up:	One 450V, 120µF; United Chemi-Con EKXJ451ELL121MM45S
CY1:	10nF equivalence (Two paralleled banks of 2x 10nF capacitors in series), Knowles Syfer 2220YA250103KXTB16
CY2:	10nF, 250VAC; Knowles Syfer 2220YA250103KXTB16

Figure 1: Typical AeroQor connection diagram

Section 3 – Schematic

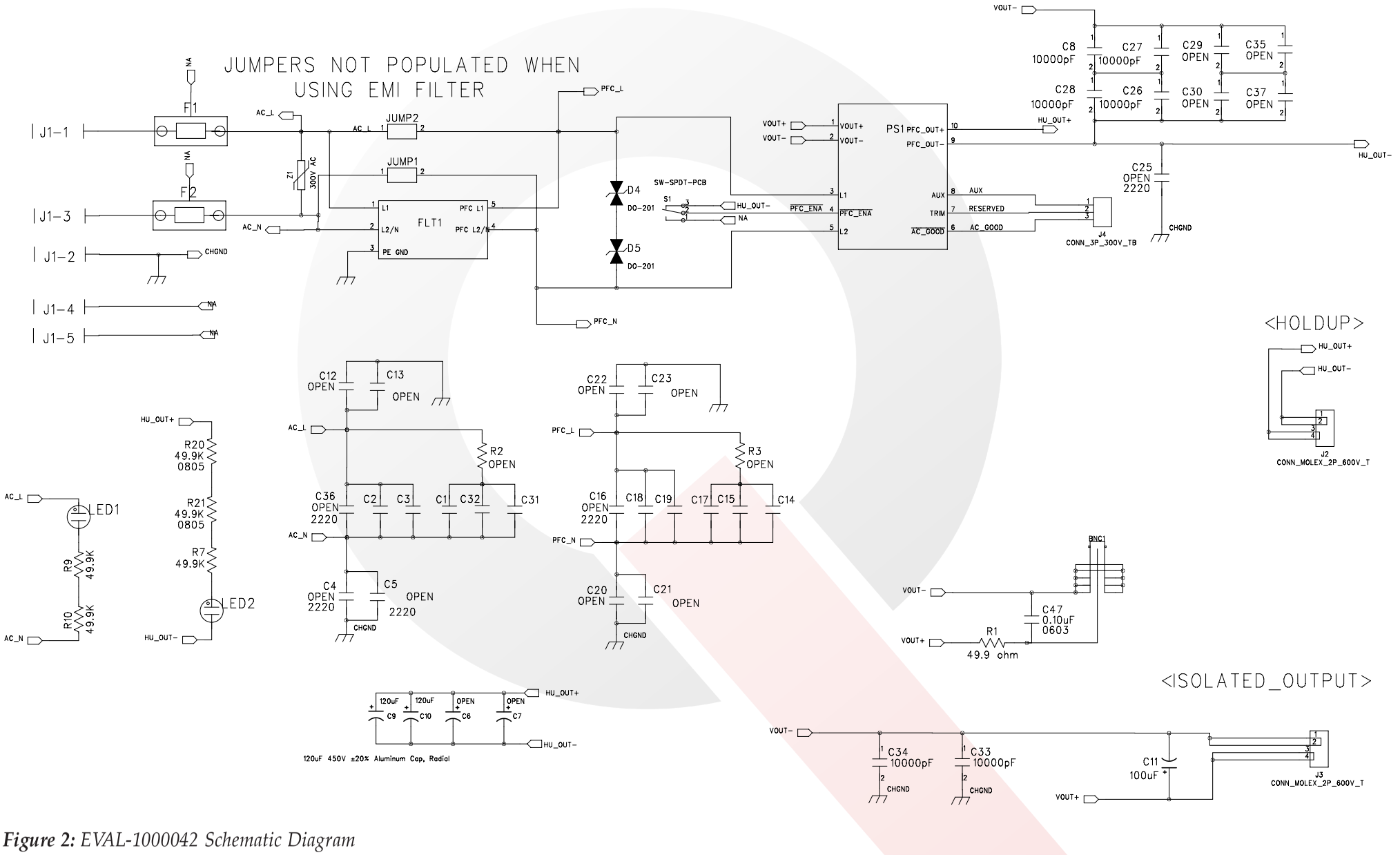


Figure 2: EVAL-1000042 Schematic Diagram

Section 4 – Component Placement

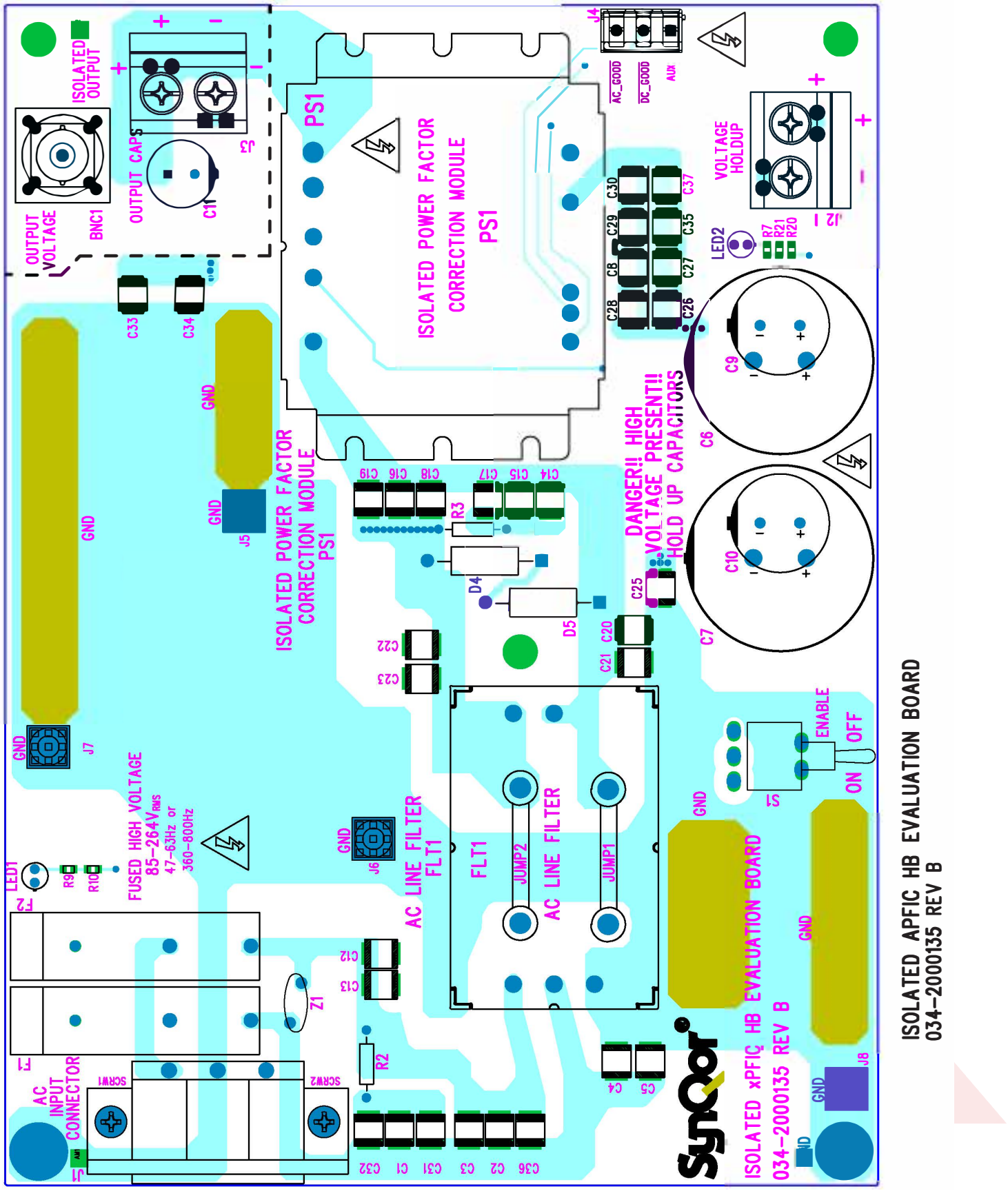


Figure 3: EVAL-1000042 board component placement

Section 5 – Input and Output Connections

Input power is applied through a standard 3-pin male IEC connector J1 (*Table 1*). Use a standard 3-pin IEC female mating cord connected to an 85 to 264 Vrms source.

Isolated output power is applied through connector J3 (*Table 4*), additional external hold-up capacitance can be connected to J2 (*Table 3*), and AC_GOOD and AUX are connected to J4 (*Table 5*).

Table 2: Input Power Connector J1

Connector Terminal #	Signal Name
J1-1	Line 2 / Neutral (L2/N)
J1-2	Earth Ground (PE GND)
J1-3	Line 1 (L1)

Table 3: External Hold-Up Connectors

Connector Terminal #	Signal Name
J2 Labeled "+"	Positive Hold-Up Output (+Hu)
J2 Labeled "-"	Negative Hold-Up Output (-Hu)

Table 4: Output Power Connector

Connector Terminal #	Signal Name
J3 Labeled "+"	Positive Output (+Vout)
J3 Labeled "-"	Negative Output (-Vout)

Table 5: Signal Connectors

Connector Terminal #	Signal Name
J4-1 Labeled (AC_GOOD)	Negative Logic AC Good Signal
J4-2 Labeled (DC_GOOD)	Negative Logic DC Good Signal
J4-3 Labeled (AUX)	Auxiliary Bias Power Supply

Note: Please refer to the appropriate SynQor converter datasheet for descriptions of these features

Section 6 – Switches, Test Points and BNC Connectors

Description of Switches

Enable On/Off Switch

Toggling S1 switch to the ON position enables the isolated PFC converter. Toggling S1 switch to the OFF position disables the isolated PFC converter

Description of Lights

Neon Lamp Indicators

LED1: Fused High Voltage Present (input)

LED2: Hold-up Capacitor Is Charged

Description of Transient Protection Devices

The evaluation board includes a protective MOV device across the input voltage lines (L1 to L2/N). This is in place to absorb energy from potential transients that may be present on your line. Transient voltage suppressor (TVS) are included after the filter to suppress low energy ringing that can be stimulated by an input transient on your line. Note that we do not recommend using this evaluation board for testing the APFIC solution against any of the Civil Aviation standards

MOV Devices

Z1: Fused L1 to Fused L2/N before filter

MOV Devices

D4 and D5: Post-filter L1 to Fused L2/N

Section 7 – Basic Operation Instructions

Apply the single-phase input, 115 Vrms at J1 in upper left, using a standard IEC female cable assembly. Lamp L1 indicates the presence of hazardous voltages at the input.

Connect the load to Isolated Output (J3)

Connect additional hold-up capacitance to Hold-Up Output (J2) if desired. The converter requires a minimum of 50 µf. The assembly comes with 240 µf. See the datasheet application section for details.

Use Switch S1 in lower right for enable / disable control.

Additional Information

A placement is included on the evaluation board for an optional quarter brick filter at the input, but is not required for operation of this evaluation board. JUMP1 and JUMP2 can be populated when the AC line filter is not being used.

Transient suppression and fusing are included near the input connector to help protect the board and modules. The evaluation board is not intended to be used to pass any DO-160G, Airbus or Boeing testing or safety requirements.

The secondary output of the APFIC is isolated from the AC source. Hold-up voltage and control signals are primary referenced and it is therefore hazardous voltages. Care must be taken to avoid contact with primary voltages, as well as with the AC source voltage.

Appendix A – Bill of Materials (BOM)

Ref Des	Value	Package	Description
BNC1		BNCPC\500	BNC PC MOUNT 5PIN .500"
C1	OPEN	2220	
C11	OPEN	Radial TH 12.5x5mmLS	Aluminum electrolytic capacitor
C12	OPEN	2220	
C13	OPEN	2220	
C14	OPEN	2220	
C15	OPEN	2220	
C16	OPEN	2220	
C17	OPEN	2220	
C18	OPEN	2220	
C19	OPEN	2220	
C2	OPEN	2220	
C20	OPEN	2220	
C21	OPEN	2220	
C22	OPEN	2220	
C23	OPEN	2220	
C25	OPEN	2220	
C3	OPEN	2220	
C31	OPEN	2220	
C32	OPEN	2220	
C36	OPEN	2220	
C4	OPEN	2220	
C47	0.10 µF	0603	X7R 16 V
C5	OPEN	2220	
C6	OPEN	Radial TH 35x10mmLS	Aluminum electrolytic capacitor (Overlays C9)
C7	OPEN	Radial TH 35x10mmLS	Aluminum electrolytic capacitor (Overlays C10)
C8, C26-28	10 nF	2220	
C9, C10	120 µF	Radial TH 18x7.5mmLS	Aluminum electrolytic capacitor, 450V, 20%
C29, 30, 35, 37	OPEN	2220	
C33, C34	OPEN	2220	
D4			200 V Transorb, Bi-directional, Axial (Vishay 1.5KE200CA)
D5			200 V Transorb, Bi-directional, Axial (Vishay 1.5KE200CA)
F1	5 A, 250 V	1 1/4" x 1/4"	Fuse Holder, PCB Mount and Fuse (Bussmann ABC-5-R)
F2	5 A, 250 V	1 1/4" x 1/4"	Fuse Holder, PCB Mount and Fuse (Bussmann ABC-5-R)
J1		IEC320, C14	
J2		2 Pos Terminal Block	600 V, 6 A, 6-18 AWG Wire
J3		2 Pos Terminal Block	600 V, 6 A, 6-18 AWG Wire
J4		3 Pos Terminal Block	300 V, 13.5 A, 16-30 AWG Wire
JUMP1	OPEN		Current Loop Jumper Wire, 14 AWG Bus Wire (Used to bypass filter)
JUMP2	OPEN		Current Loop Jumper Wire, 14 AWG Bus Wire (Used to bypass filter)
LED1		Radial	Neon Lamp
LED2		Radial	Neon Lamp
R1	49.9 Ω	0603	Resistor
R10	49.9 K	0805	Pulse Proof Resistor
R2	OPEN	Axial	Resistor
R20	49.9 K	0805	Pulse Proof Resistor
R21	49.9 K	0805	Pulse Proof Resistor
R3	OPEN	Axial	Resistor
R7	49.9 K	0805	Pulse Proof Resistor
R9	49.9 K	0805	Pulse Proof Resistor
S1			On-Off Toggle Switch
Z1	300 Vac	10.0 mm	Metal Oxide Varistor (TDK B72210S2301K101)