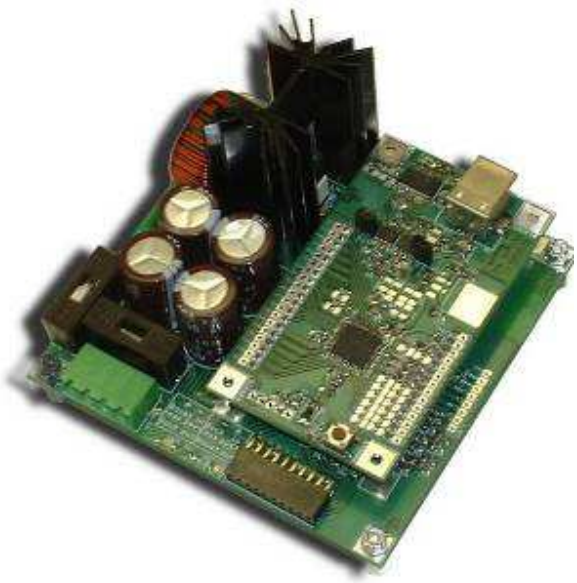
Features

- Control Options
  - Open/Closed loop
  - Switching frequency
  - Synchronous switching
  - Controller type/gain
- Hard I & V limits
- Hard Duty Cycle limit
- I/O sensing
- Interactive Digital Control
- Active Data Logger
- USB Interface



Description

The PE-iLab (power electronics interactive lab) is a system consisting of a power and control board. The power board houses the DC-DC converter capable of operating in either buck or boost* mode depending on how the source and load are connected to the system. The control board contains the DSP and the USB interface for connecting to a computer. The PE-iLab is used as an educational training tool to help students grasp a better understanding of several key areas of power electronics and digital control. In addition, the PE-iLab has two active switches enabling buck or boost* operation in discontinuous or continuous (synchronous switching) conduction mode.

Absolute Maximum Ratings

	Parameters	Max.	Unit
Vin_{buck}, $Vout_{boost}$	Input Voltage Buck Mode, Output Voltage Boost Mode	60	V
$Vout_{buck}$	Output Voltage Buck Mode	60	V
Vin_{boost}	Input Voltage Boost Mode	30	V
I_{load}	Load Current Buck Mode, Boost Mode	5	A
T_A	Ambient Operating Temperature	40	˚C
T_{STG}	Storage Temperature	85	˚C

Table 1 Absolute Maximum Ratings

Electrical Characteristics

T_A=25˚C

	Parameter	Min.	Typ.	Max.	Unit	Conditions
Vin_{buck}	Input Voltage Buck Mode	15	-	60	V	
$Vout_{buck}$	Output Voltage Buck Mode	0	-	60	V	
Vin_{boost}	Input Voltage Boost Mode	15	-	30	V	(1)
$Vout_{boost}$	Output Voltage Boost Mode	-	-	60	V	(1)
$I_{in/out}$	Current In/Out	-	-	5	A	
$Rsense_{in\ /\ out\ /\ inductor}$	Current Sense Resistance In/Out/Inductor	-	20	-	mΩ	
C_{in}/C_{out}	Total Capacitance In/Out	-	660	-	µF	
ESR_C	Total Capacitor ESR In/Out	-	45	-	mΩ	1 kHz
L	Inductance	20	25	30	µH	
ESR_L	Inductor ESR	-	7	-	mΩ	
R_{DS}(on)	Drain to Source Resistance of High & Low-side Switch	-	14	18	mΩ	V_{GS}=10V
V_{GS}	Gate Drive Voltage	-	10	-	V	
F_{SW}	Switching Frequency	50	100	200	kHz	

Table 2 Electrical Characteristics

PE-iLab Block Diagram

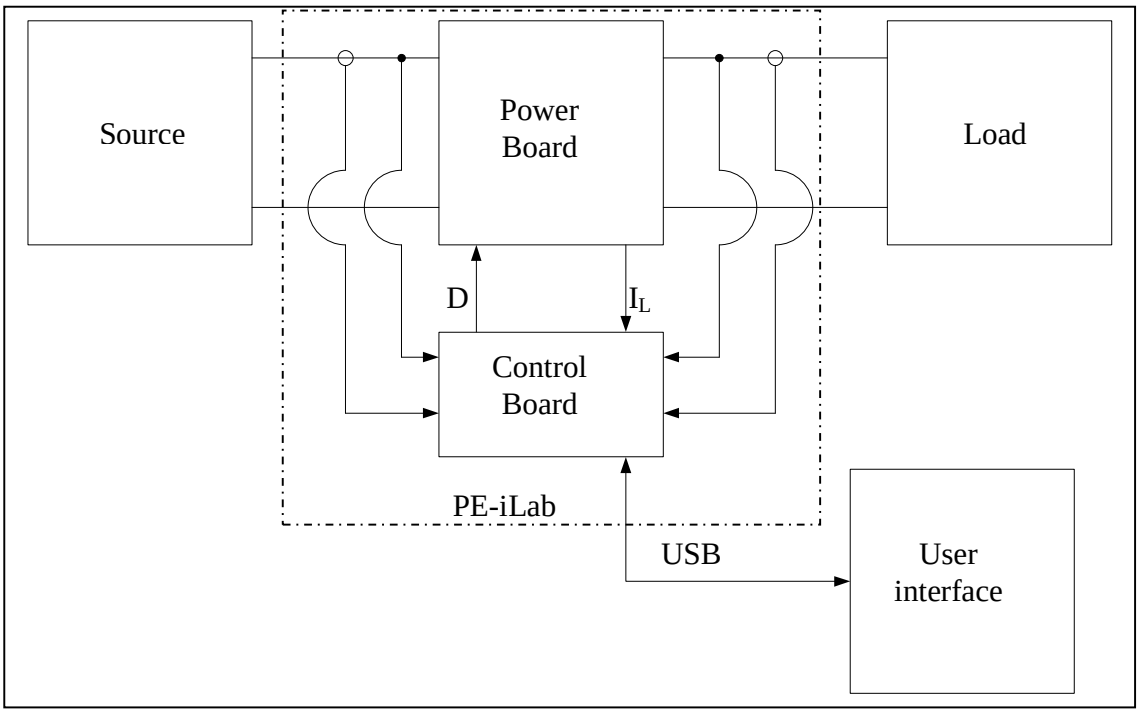


Figure 1 Overall Block Diagram

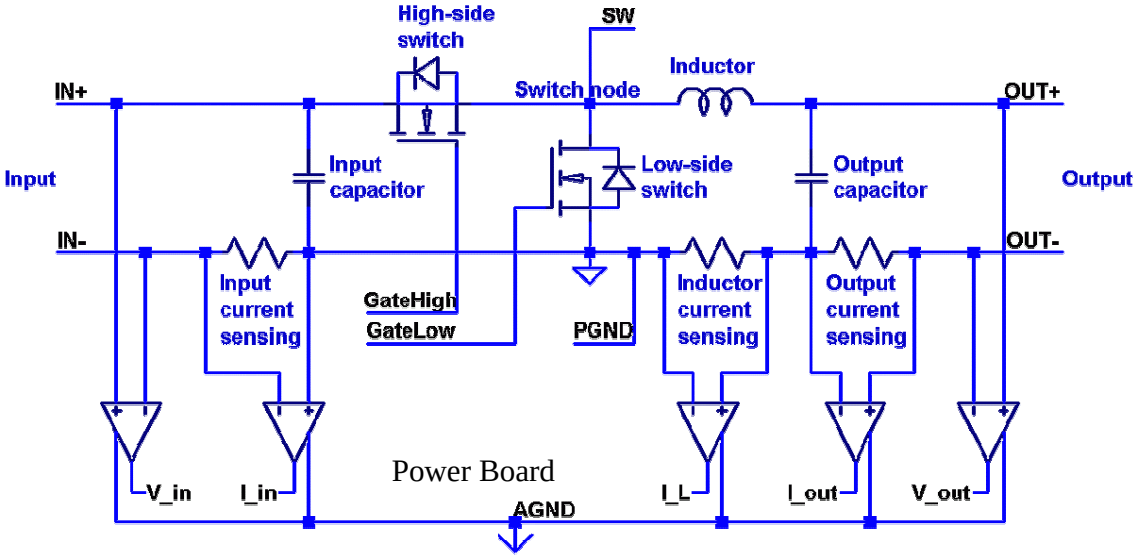


Figure 2 Diagram of Power Board

Power Stage Test Points [4]

Name	Description	Measure in reference to (w/o differential probe)	Measure in reference to (w/ differential probe)
IN+	Positive input voltage [2]	GND	IN-
IN-	Negative input voltage [2]	-	-
OUT+	Positive output voltage [2]	GND	OUT-
OUT-	Negative output voltage [2]	-	-
V_OUT	Sensed output voltage [2,5]	GND	AGND
V_IN	Sensed input voltage [2,5]	GND	AGND
I_IN	Sensed output current [2,5]	GND	AGND
I_L	Sensed inductor current [5]	GND	AGND
I_OUT	Sensed input current [2,5]	GND	AGND
AGND	Analog ground	-	-
GND	Signal ground	-	-
VCC	+5 V supply for DSP	GND	GND
PGND	Power ground	-	-
GATELOW	Low-side gate voltage	GND	PGND
SW	Switch node	GND	PGND
GATEHIGH	High-side gate voltage	[3]	SW

Table 3 Test Points

Notes:
* Depending on installed software version the hardware can operate in buck, boost or in both modes
[1] Parameters for operation in Boost mode
[2] Referenced to use in Buck mode, switch “IN” and “OUT” for Boost mode
[3] Must be referenced to SW, if no differential probes available only use ONE probe
[4] IN-, OUT-, PGND, GND and AGND are not directly connected to each other and MUST NOT be shorted together
[5] Sensed value is the actual value with a scale and offset

Pin Diagrams

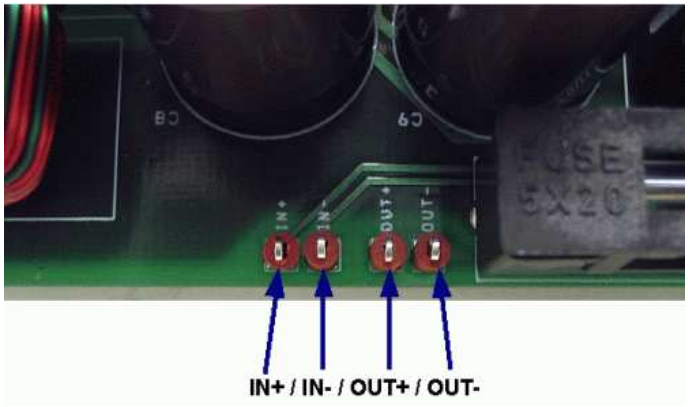


Figure 3 Test Points of Input and Output Voltage

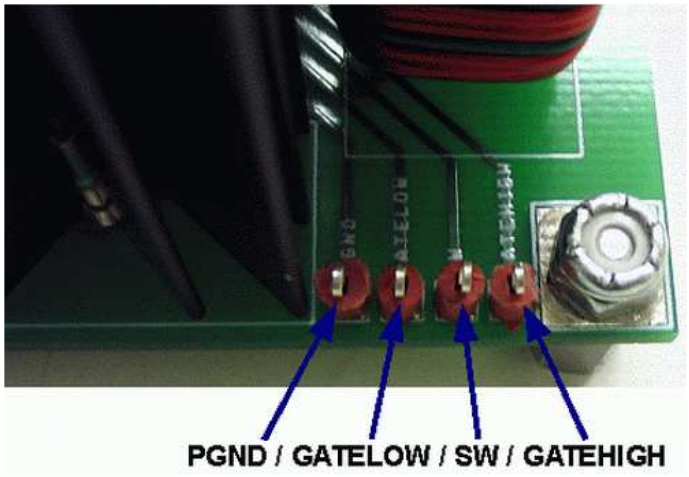


Figure 4 Test Points of Switching Signals

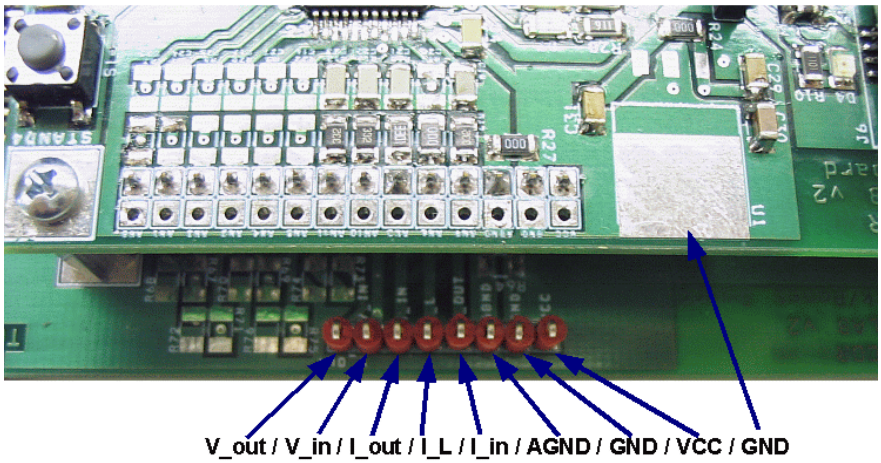


Figure 5 Test Points of Sensed Values, Grounds and VCC

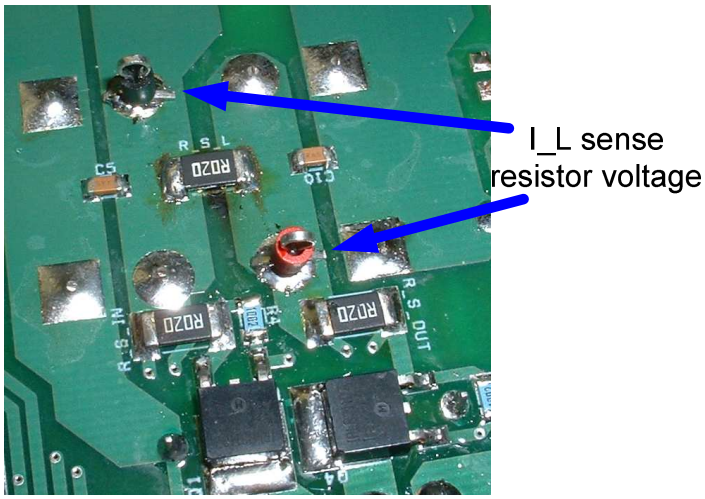


Figure 6 Voltage of Sensed Inductor current (w/o scaling and offset)

Scaling and Offset of Sensed Values

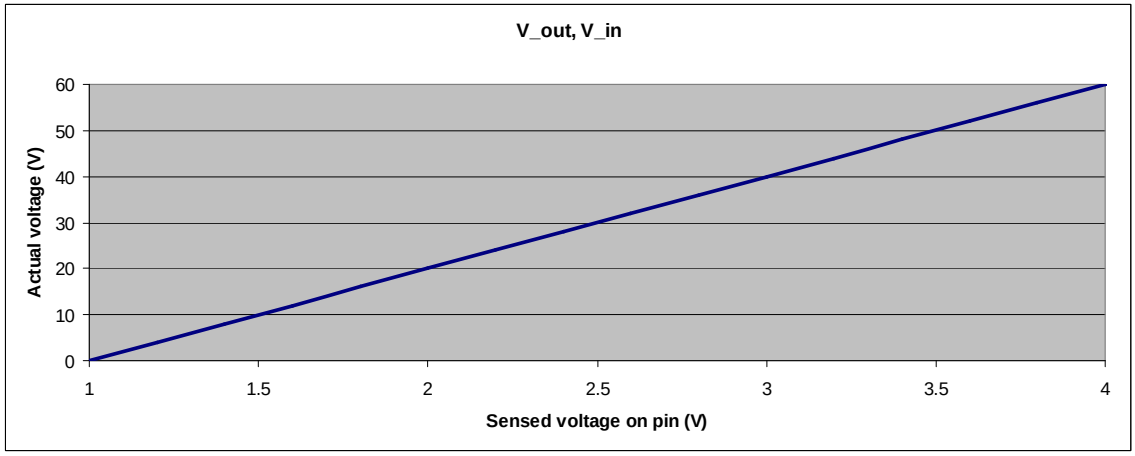


Figure 7 Input/Output Voltage vs. Sensed Input/Output Voltage V_in_sense/V_out_sense (see Figure 5)

output voltage (V) = [V_out_sense(V) - 1V] × 20
input voltage (V) = [V_in_sense(V) - 1V] × 20

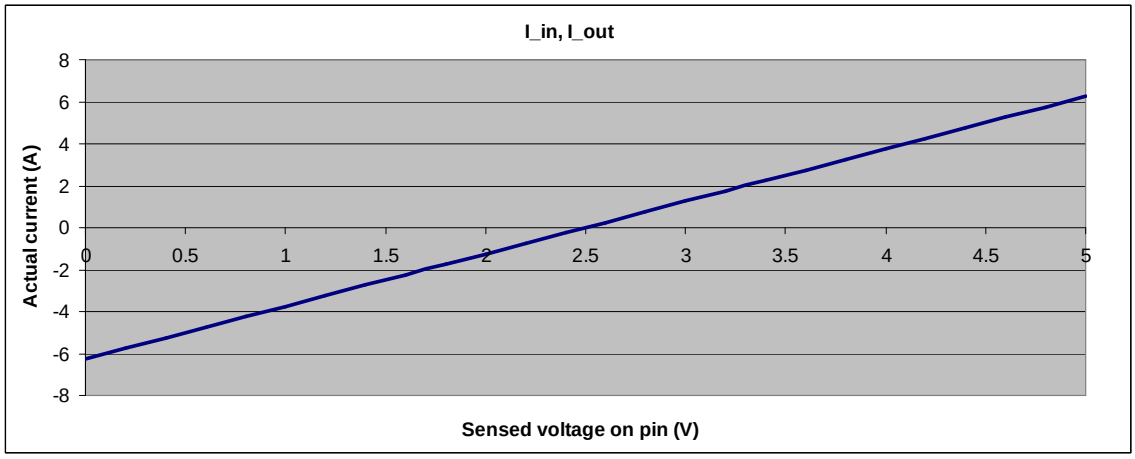


Figure 8 Input/Output Current vs. Sensed Input/Output Current I_in/I_out (see Figure 5)

input current (A) = [I_in(V) - 2.5V] × 2.5
output current (A) = [I_out(V) - 2.5V] × 2.5

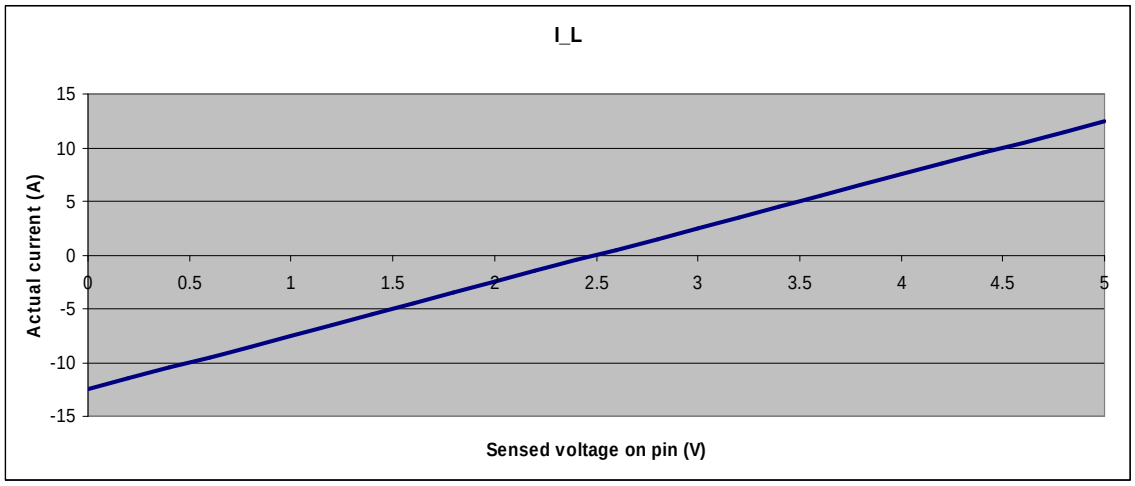


Figure 9 Inductor Current vs. Sensed Inductor Current I_L (on top of power board, see Figure 5)

inductor current (A) = [I_L(V) - 2.5V] × 5

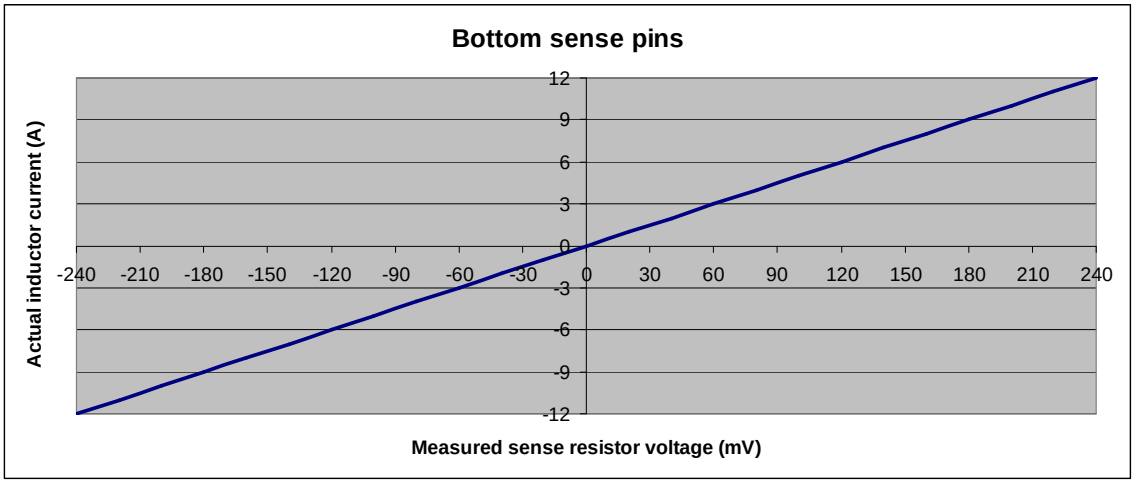


Figure 10 Inductor Current vs. Inductor Current Sense Resistor Voltage I_L_meas (on bottom of power board, see Figure 6)

inductor current (A) = I_L_meas(mV) × 0.05

PE-iLab Jumpers

The PE-iLab has two jumpers on the control board. These two jumpers are used to power the DSP under different operating conditions.

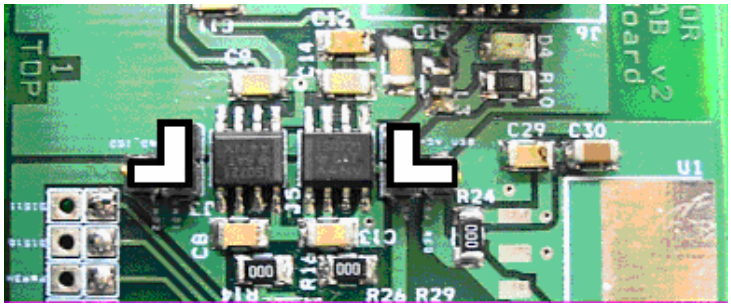


Figure 11 Jumper Location

The DSP board can operate as a stand-alone unit and pull needed power from the USB port of the PC. Therefore, the two jumpers (see Figure 12) need to be set to connect across the isolation barrier. This setup is helpful while becoming familiar with the DSP and interface software and to verify correct operation.

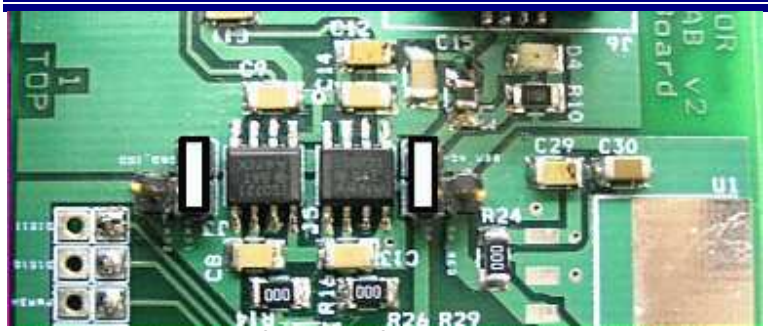


Figure 12 Jumper Configuration for Stand-Alone Mode (no power board)

When the DSP board is plugged into the power stage board, the two jumpers (see Figure 13) need to be changed to be in parallel with the isolation barrier. Thus, the DSP will pull power from the power stage board once an input voltage is applied to it. With this setup, the power stage can be operated while the connection to the PC is completely isolated, which guarantees a safe operation independent of the used source and load.

Figure 13 Jumper Configuration for Normal Operation (w/ power board)

Position	Function
Parallel to isolation boarder [1.]	DSP receives power from power board
Across the isolation boarder [2.]	DSP receives power from USB connection

Table 4 Jumper Position and Function

Notes:
[1.] See Figure 13 use when control board is plugged into power board
[2.] See Figure 12 CANNOT use when control board is plugged into power board

Package Outline

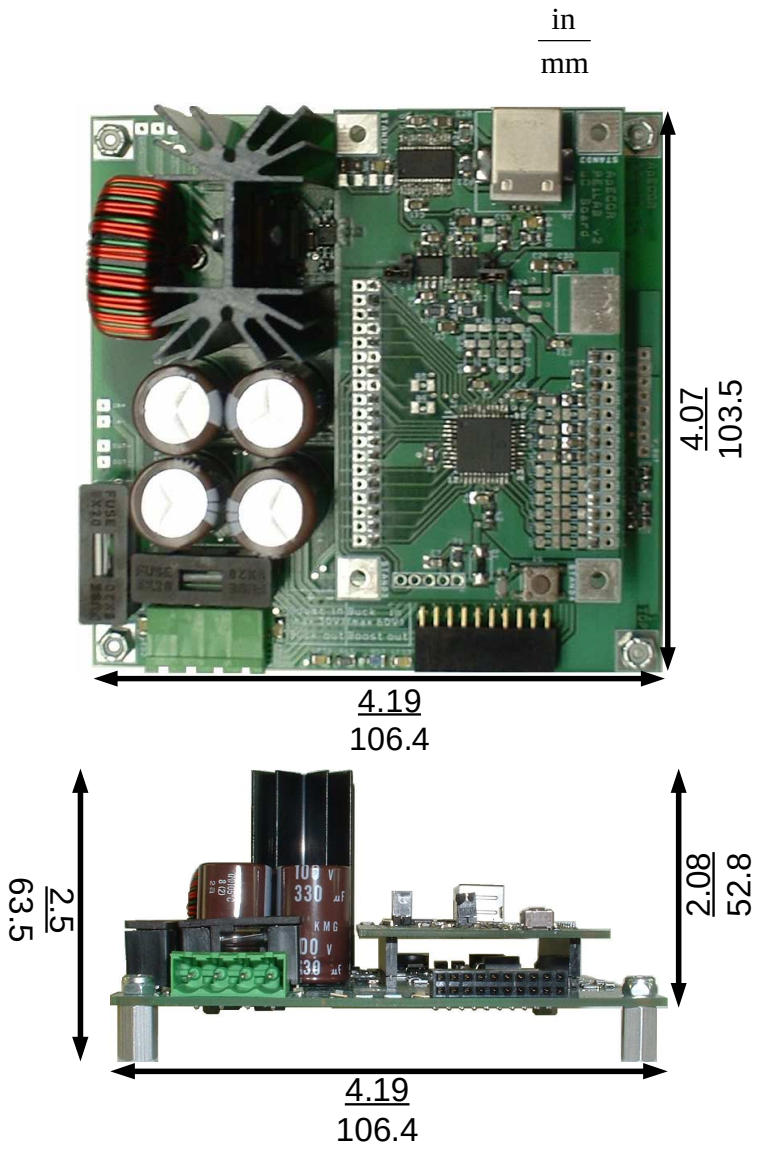


Figure 14 PE-iLab Dimensions