

# LP3905-A3 Application Board Information

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National Semiconductor  
Application Note 1527  
Graham Roxburgh  
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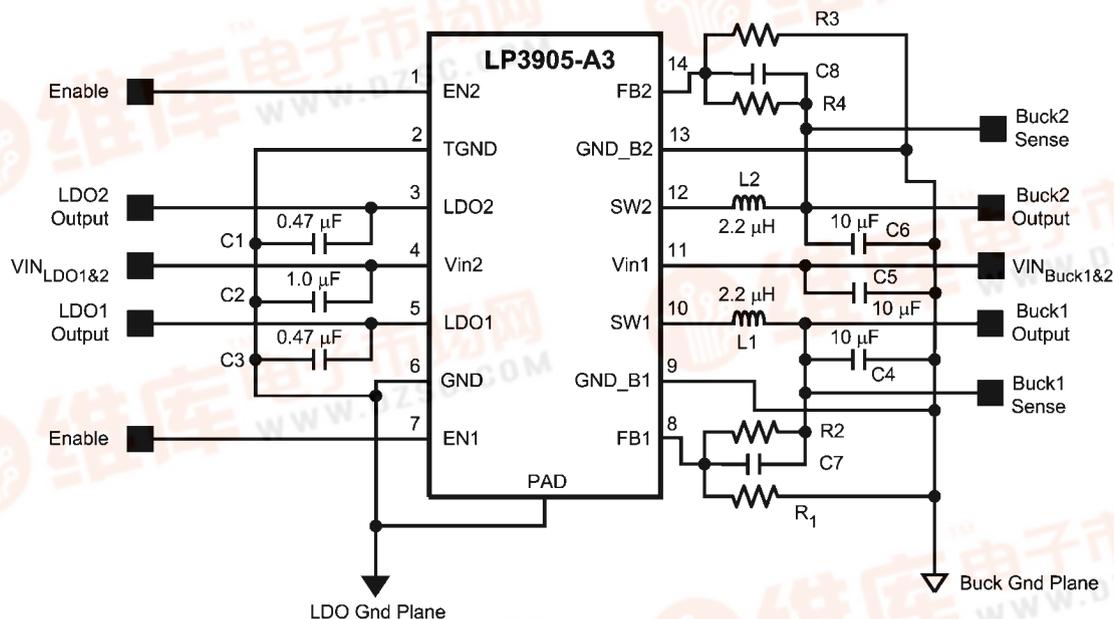
## General Information

The evaluation board is a complete circuit allowing full operation of the LP3905 within the recommended application circuit. Each board is pre-assembled and tested in the factory. The board contains the LP3905-A3 in a 14 lead LLP package with all the associated passive components to enable all features of the device to be tested.

LP3905 is optimized for low power handheld applications. This device provides two 600mA DC/DC Buck regulators, and

two 100mA linear regulators as configured on the board. The LP3905-A3 allows the two buck output voltages to be set by the user. This option is a variation on the LP3905 device which has 4 fixed output voltages. The LP3905 additionally features two enable pins allowing control over the device outputs.

## Schematic Diagram



Evaluation Board Schematic

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## Operational Information

The circuit used in the evaluation board is shown above.

The LP3905-A3 evaluation board has the output voltages set as follows:

### LP3905-A3 Output Voltages

O/P	Voltage (V)
Buck1	1.5
Buck2	1.85
LDO1	3.0
LDO2	2.8

The board is fitted with 0.47µF capacitors on the outputs of the LDO's and thus the load current for these LDO's should not exceed 100mA.

The device has 1MΩ internal resistors from EN1 and EN2 to GND.

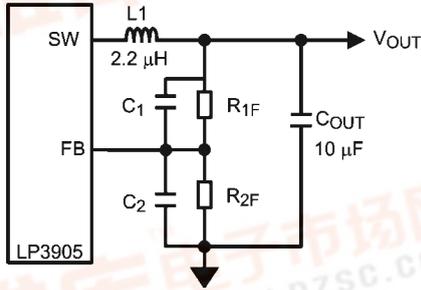


## Output Voltage Pre-set

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For initial use the LP3905-A3 sample board has been pre-set to 1.5V and 1.85V. The outputs of these two regulators may be set via the selection of the external resistor network forming the output feedback between the output voltage side of the inductor and the feedback pins (FB1, FB2) of the device and the feedback pins and ground. The user should thus alter the values of R1, R2 and C7 to give the desired output voltage on Buck1 and R3, R4, and C8 to change the output voltage on Buck2.

## Output Voltage Selection



Adjustable Buck Components showing Resistor Feedback Network

The recommended resistance between FB and GND is around 200kΩ. At this level the current through the resistor

network is low but does not give rise to noise problems. The feedback node voltage is 0.5V and hence a 200kΩ resistor will result in a 2.5μA current.

The formula for output voltage selection is

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R_{1F}}{R_{2F}}\right)$$

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- $V_{OUT}$  - output voltage (Volts)
  - $V_{FB}$  - feedback voltage (0.5V)
  - $R_{1F}$  - feedback resistor ( $V_{OUT}$  to FB)
  - $R_{2F}$  - feedback resistor (FB to GND)

For any output voltage greater than or equal to 1.0V, a capacitor should be added across  $R_{1F}$ . The chosen value of the capacitor is governed by the formula

$$C_1 = \frac{1}{(2 \times \pi \times R_{1F} \times 45 \times 10^3)}$$

The value of this capacitor may be chosen from the following table giving the recommended component values for specified output voltages. C2 shown between the FB node and GND is only required at higher output voltages.

## Recommended Component Values for Specified Output Voltages

$V_{OUT}$ (V)	$R_{1F}$ (kΩ)	$R_{2F}$ (kΩ)	C1 (pF)	C2 (pF)
1.0	200	200	18	none
1.2	280	200	12	none
1.4	357	200	10	none
1.5	365	182	10	none
1.6	442	200	8.2	none
1.85	536	200	6.8	none
2.5	402	100	8.2	none
2.8	464	100	8.2	33
3.3	562	100	6.8	33



## Connection Information

Connect a supply voltage (3.0V to 5.5V) to either of the VIN pins on the evaluation board. LK4 hardwired on the board connects both the BUCK supply side to the LDO supply side. These supplies are both required to correctly power the device.

Supply ground may be connected at either GND or BKGND. LK3 which is hardwired on the eval board connects the BUCK gnd to the LDO gnd.

For best results in current measurements on the Buck outputs, use 4 wire measurement techniques to eliminate any voltage drop on the PCB traces or connecting wires to the loads. For this the instrument sense connection should be connected to the corresponding buck 'S' (sense) connection on the evaluation board.

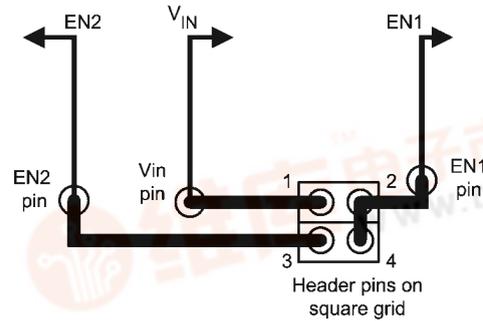
Input leads should be kept reasonably short to minimize inductance.

ON/OFF control is provided by logic signals on EN1 and EN2. A minimum of 1.2V is required on these pins to enable the corresponding outputs. The outputs will be shutdown with the enable pins set to 0.4V or less. If ON/OFF control is not required, then either or both enable pins may be connected to  $V_{IN}$  either externally or by using the on-board connection matrix.

A number of control options are provided on board by either hardwiring or using reconfigurable links on the 4-way matrix.

### Link Matrix Details

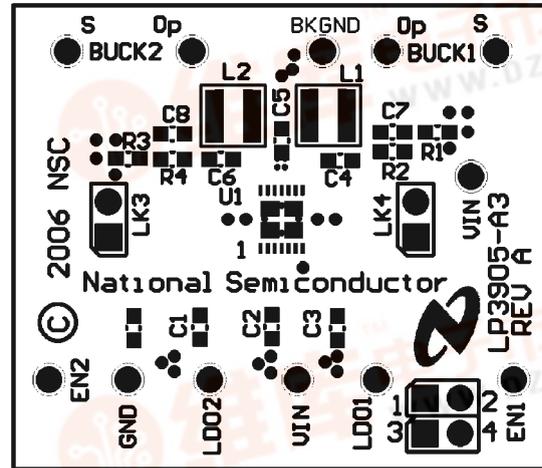
Link	Link	Connection Description
1 - 2	3 - 4	EN1 and EN2 connect to VIN supply. All outputs power on with the supply voltage.
3 - 4	-	EN1 connects to EN2 and may be driven externally from one source to control all outputs.
1 - 2	-	EN1 connects to VIN. Buck1, LDO1, and LDO2 outputs are enabled at device power up. Buck 2 should be enabled separately using an external source connected to EN2.
1 - 3	-	EN2 connects to VIN. Buck 2 is enabled at device power up. Buck1, LDO1, and LDO2 outputs should be enabled using an external source connected to EN1.
-	-	Both EN1 and EN2 can be driven separately from external sources connected at the board inputs EN1 and EN2.



Link Matrix Diagram

20209105

### PCB Layout



PCB Component and Pin Layout  
Board Size 1.5" x 1.3"

20209102

## Bill of Materials for LP3905-A3 LLP Evaluation Board

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Item	Type	Value	Qty	Part Number Suggested	Manufacturer	Footprint
U1			1	LP3905-A3	NSC	SDA14B
L1,L2	Inductor	2.2 $\mu$ F	1	DO3314-222MLB*	Coilcraft	
C1, C3	Capacitor	0.47 $\mu$ F	2	GRM188R61A474KA61D*	Murata	0603
C4, C5, C6	Capacitor	10 $\mu$ F	3	GRM21BR61A106KE19L*	Murata	0805
C2	Capacitor	1.0nF	1	GRM188R61A105KA61D*	Murata	0603
C7	Capacitor	10pF	1	GRM1885C1H100JZ01B*	Murata	0603
C8	Capacitor	6.8pF	1	GRM1885C1H6R8DZ01B*	Murata	0603
R1	Resistor	182 $\Omega$	1	CRCW06031823F*	Vishay	0603, 1%
R2	Resistor	365 $\Omega$	1	CRCW06033653F*	Vishay	0603, 1%
R3	Resistor	200 $\Omega$	1	CRCW06032003F*	Vishay	0603, 1%
R4	Resistor	536 $\Omega$	1	CRCW06035363F*	Vishay	0603, 1%

\* - or similar.



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LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Reference Designs	<a href="http://www.national.com/refdesigns">www.national.com/refdesigns</a>
Power Management	<a href="http://www.national.com/power">www.national.com/power</a>	Feedback	<a href="http://www.national.com/feedback">www.national.com/feedback</a>
Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>		
LDOs	<a href="http://www.national.com/ldo">www.national.com/ldo</a>		
LED Lighting	<a href="http://www.national.com/led">www.national.com/led</a>		
PowerWise	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>		
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