AN-1620 LP3971 USB Evaluation Board Rev F

1 General Description

The LP3971 Flex PMU is a complete power management IC designed for advanced applications processors. It contains 5 low noise low dropout regulators, 3 DC/DC buck converters, a backup battery charger, real time clock supply regulator [RTC], 2 GPO's and high speed I^2C serial interface to program individual regulator output voltages as well as offer on/off control. This USB evaluation board features independent USB powering, virtual voltmeter bank all in a compact demonstration platform.

2 Key Features

- 2.7V to 5.5V input voltage range
- Programmable V_{OUT} 0.8V to 3.3V
- Up to 95% efficiency
- ±3% output voltage accuracy
- 1.5A output current [bucks]

3 Applications

- Personal Media Players
- Smart Phones
- PDA Phones
- Digital Cameras

4 Evaluation Board/Kit Overview

The LP3971 Evaluation Board, Figure 1, supports complete functional evaluation of the power management IC. The functions of the chip are controlled by the I^2C interface. The I^2C interface on the rev A, B, C, E, F, and later USB boards are driven via a COP8 microprocessor which supports a connection via the USB port and offers chip powering and virtual software voltage measurement of all regulators. In addition, the LP3971 can be powered directly through the USB port for full function. If high current Buck testing is desired, an external LI ION cell or PS capable of supplying 2 amps will need to be connected to the appropriate connector.

The evaluation board/kit consists of:

- LP3971 Flex_PMU device soldered down in LQA-40 pin 5X5 LD package
- Full USB interface
- LED LDO monitoring with current limit resistors [selectable]
- External power LDO, Buck output and main battery/supply connectors offered in heavy duty turret pins and solder pads
- Socket for back-up battery
- Users guide
- Codeloader Software version 1.2.0 or greater [may be sent via email]

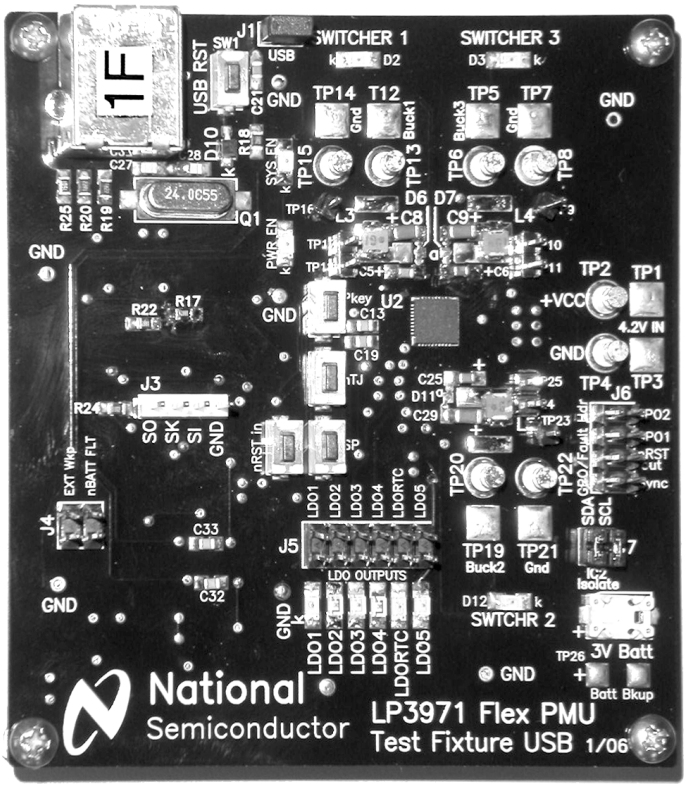

Figure 1. LP3971 Evaluation Board Version F

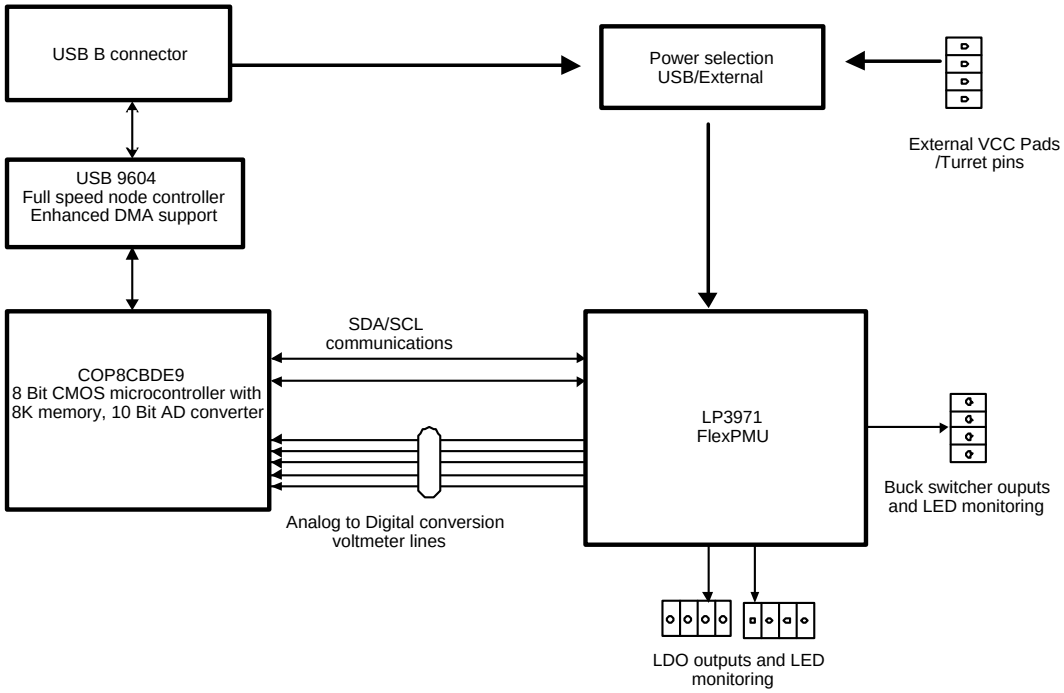

Figure 2. LP3971 Flex_PMU USB Evaluation Board Block Operational Diagram

5 Pin Description 5 × 5 Package

Pin #	Name	I/O [1]	Type [1]	Description
1	PKEY	I	D	CPU Wakeup Input
2	nTJ	I	D	CPU Wakeup Input
3	SP	I	D	CPU Wakeup Input
4	EXT_WAKEUP	O	D	CPU Wakeup Input
5	FB1, Feedback Buck1	I	A	Buck 1 Feedback
6	$V_{IN1} = V_{Batt}$	I	P	Battery Input for Powering Internal Circuits and LDO1–3
7	LDO_V_{OUT}_1	O	P	LDO1 Output
8	LDO_V_{OUT}_2	O	P	LDO2 Output
9	nRST In	I	D	Chip Reset Input
10	LDO GND 1	G	G	Ground
11	LDO_{REF} Bypass	O	A	Bypass Capacitor for Reference
12	LDO_V_{OUT}_3	O	P	LDO3 Output
13	LDO_V_{OUT}_4	O	P	LDO4 Output
14	V_{IN} LDO_4	I	P	Input Power for LDO4
15	Back-Up Battery V_{IN}	I	P	Back Up Battery Input
16	LDO_V_{OUT}_0 (RTC)	O	P	LDO-RTC Output
17	nBatt_FLT	O	D	Main Battery Fault Output
18	PGND Buck2	G	G	Ground
19	V_{OUT} Buck2	O	P	Buck Switcher 2 Output
20	V_{IN} Buck2	I	P	Buck Switcher 2 Battery Input
21	SDA	I/O	D	I^2C Data Line
22	SCL	I	D	I^2C Clock Input
23	FB2, Feedback Buck2	I	A	Buck Switcher 2 Feedback
24	nRST Out	O	D	Reset Output
25	LDO_V_{OUT}_5	O	P	LDO5 Output
26	V_{IN2} (LDO 5 Only)	I	P	Battery Input Power for LDO5
27	VDDA	I	P	Analog Power Input
28	FB3, Feedback Buck3	I	A	Buck Switcher 3 Feedback
29	GPIO1	I/O	D	General Purpose I/O #1
30	GPIO2	I/O	D	General Purpose I/O #2
31	V_{IN} Buck3	I	P	Buck Switcher 3 Battery Input
32	V_{OUT} Buck3	I	P	Buck Switcher 2 Output
33	PGND Buck3	G	G	Buck3 NMOS Power Ground
34	Buck 1 2 & 3 AVSS/NCHBLK	G	G	Buck1, 2, 3 Analog Ground
35	SYNC (Buck Clock Input)	I	D	Buck Switcher External Clock Input
36	Sys_En	I	D	Power Domain Enable
37	Pwr_En	I	D	Power Domain Enable
38	PGND Buck1	G	G	Buck1 NMOS Power Ground
39	V_{OUT} Buck1	O	P	Buck Switcher 1 Output
40	V_{IN} Buck1	I	P	Buck Switcher 1 Battery Input

(1) A: Analog Pin; D: Digital Pin; G: Ground Pin; I: Input Pin; I/O: Input/Output; O: Output Pin; P: Power Pin

6 Operating Instructions

The following instructions give general instructions for use of LP3971 with the evaluation board. Practice standard ESD protection (ground cable) to prevent any unwanted damaging ESD events.

1. Check that the jumpers are in default settings (jumpers are introduced later on this document).
2. Load version 1.2.0 or later of the codeloader program into PC.
3. Connect the USB cable [standard USB AB cable] from the USB connector to PC port.
4. Open the codeloader program up, verify that “USB” port has been selected.
5. Verify that successful communications link has been established by toggling “READ ALL”.
6. If there is no communication, key the USB RST [SW1] switch once on the board for reboot.
7. If the voltmeter monitoring function is desired, select “POLL STATUS”.
8. LDO/buck outputs may be monitored directly off the appropriate header output pins.
9. Note that for full load testing, an external PS must be connected to TP1/TP2 and jumper J1 must be removed. This is because the USB port source spec is limited to 500 mA and removing the jumper will disconnect the USB supply.
10. PWR EN/SYS En is selectable via codeloader software assignment.
11. Hardware reset can be accomplished by pressing the nREST_In momentary switch.
12. Battery backup is possible by inserting appropriate rechargeable cell into supplied holder.
13. Switches PKEY, nTJ, and SP, are provided for use in normal evaluation mode.

7 List of Components

Item	Qty	Reference	Value	Pkg.	Manuf.	Part Number
1	5	C1, C21, CC, CD, CF1	10 µF	0805	Panasonic	ECJ2FF1A106Z
2	2	C2, C3	100 µF	3528–21	Kemet	T520B107M006ASE040
3	8	C4, C7, C13, C15, C16, C31, CA, CB	1 µF	0805	Kemet	C0805C105K4RACTU
4	6	C5, C6, C8, C9, C25, C29	10 µF	1206	Taiyo-Yuden	JMK316BJ106M
5	6	C14, C19, C20, C23, C24, C26	0.47 µF	0805	TDK	C2012X7R1E474K
6	2	C17, C18	47 µF	0805	Murata	GRM2195C2A470JZ01D
7	4	C22, C30, C32, C33	0.1 µF	0805	Murata	GRM21BR71E104KA01L
8	2	C27, C28	15 pF	0805	Yageo	0805CG150J9B200
9	1	BT2	Battery Holder	SMT	Seiko	BH0414
10	1	NOT INSTALLED	Backup Battery	Micro4	Seiko	MS412F
11	4	D6, D7, D10, D11	Schottky	PM 457	On Semi	MBRM120LT3
12	2	D8 (PWR EN), D9 (SYS EN)	Green LED	1206	Lumex	SML-LX1206GC-TR
13	9	LDO1(D13), LDO2(D14), LDO3(D18), LDO4(D17), LD05(D19), LDORTC(D16), D2, D3, D12	Red LED	1206	Lumex	SML-LX1206IC-TR
14	2	L1, L2	1 µH Inductor	0805	TDK	MLF2012A1R0K
15	3	L3, L4, L5	2.2 µH Inductor	SMT	Toko	FDSE0312
16	1	Q1	XTAL 24 MHz 18 pF	SMD	Citizen	HCM49–24.000MABJT
17	7	R1, R2, R23, R31, R32, R33, R34	330Ω	0805	SEI	807065R330
18	1	R8	100Ω	0805	NIC	NRC10J101TR
19	1	R9	49.9Ω	0805	Rohm	MCR10EZHF49R9
20	10	R10, R11, R12, R18, R22, R24, R26, R27, R36, R37	10K	0805	Yaego	9C08052A1002FKHFT
21	1	R12	0Ω	0805	Yageo	9C08052A0R00JLHFT

Item	Qty	Reference	Value	Pkg.	Manuf.	Part Number
22	4	R15, R16, R28, R29	133Ω	0805	Rohm	MCR10EZHF1330
23	2	R19, R20	22.1Ω	0805	Vishay-Dale	CRCW080522R1ERT1
24	1	R21	1M	0805	Yageo	9C08052A1004JLH
25	1	R25	1.5k	0805	Yageo	9C08052A1501FKH
26	1	D1	45.3Ω	0805	Vishay-Dale	CRCW080545R3F100
27	5	S1, S2, S3, S4, SW1	Touch Switch	SMD	Panasonic	EVQ-PJU04K
28	1	U1	3.3V Regulator	SOT-23 5	Texas Instruments	LP2981-3.3
29	1	U2	PMU	RSB0040	Texas Instruments	LP3971
30	1	U3	USB Controller	SOIC 28	Texas Instruments	USBN9604-28M
31	1	U4	Microcontroller	TSSOP 48	Texas Instruments	COP8CBE9
32	1	U5	2V Regulator	SOT-23 5L	Texas Instruments	LP3984-2.0
33	1	U6	Voltage Converter	SOT-23-6	Texas Instruments	LM2664
34	1	J1	100 mil Header	2 pos	Amp	1 × 2 (4-103239-0-02)
35	1	J2	USB Receptacle	4 pos	FCI	61729-0010B
36	1	J3	100 mil Header	4 pos	Molex	1 × 4 (22-10-2041)
37	1	J4	100 mil Header	4 pos	Amp	2 × 2 (4-103240-0-02)
38	1	J5	100 mil Header	12 pos	Amp	2 × 5 (4-103240-0-06)
39	1	J6	GPO/LDO Headers	8 pos	Amp	2 × 4 (4-103186-0-04)
40	1	J7	2 mm Header	4 pos	Sullins	2 × 2 (PRPN022MAMP)
41	10	TP9, TP10, TP11, TP16, TP17, TP18, TP23, TP24, TP25, TP26	Test Points	1 pos	Amp	1 × (4-103185-0-01)
42	8	TP2, TP4, TP6, TP8, TP13, TP15, TP20, TP22	Turrett Terminal	0.109"L	Keystone	1502-2
43	1	LP3971 version F Fab	Bare Board	4 Layer	Rainbow Labs	LP3971-F

8 Powering and Jumpers Selection

The LP3971 USB evaluation platform offers several power connectors. These connectors are outlined in the table below. In addition, the Evaluation board has jumpers for special modes and stand-alone use. The default jumper settings are valid in normal operation and are also outlined below.

Component	Use	Comment
J5-1	Output for LDO1	Outside Pin of Connector is Grd
J5-2	Output for LDO2	Outside Pin of Connector is Grd
J5-3	Output for LDO3	Outside Pin of Connector is Grd
J5-4	Output for LDO4	Outside Pin of Connector is Grd
J5-6	Output for LDO5	Outside Pin of Connector is Grd
J5-5	Output for RTC [Real Time Clock]	Outside Pin of Connector is Grd
J4-1	Input for External Wakeup	Outside Pin of Connector is Grd
J4-2	Output for nBATT Fault	Outside Pin of Connector is Grd
J6-2	Output for nREST	Outside Pin of Connector is Grd
J6-3	GPO 1 Output	Outside Pin of Connector is Grd
J6-4	GPO 2 Output	Outside Pin of Connector is Grd
J3-1	Cop8 Microwire SO	Used for Micro Flash Only
J3-2	Cop8 Microwire SK	Used for Micro Flash Only
J3-3	Cop8 Microwire SI	Used for Micro Flash Only
J3-4	Cop8 Grd	Used for Micro Flash Only
TP12-13	Output for Buck Switcher 1	GRD is TP12-13
TP19-20	Output for Buck Switcher 2	GRD is TP21-22
TP5-6	Output for Buck Switcher 3	GRD is 7-8
USB	USB Connector	Connect to the PC Via Supplied Cable
J1	Power Usage Selection	Place Jumper for USB, NO JUMPER for External Power Input
TP1-2	Connect External V_{CC} Supply Here 3.5V–5V for High Current Testing	Doubles for LI-ION cell Input

9 Demonstration Software Window

The demonstration software enables read and write to LP3971's internal registers through PC's USB port. All the user controllable registers are usable through the software.

Installation: Run the codeloader for LP3971 version 1.2.0 or greater.

After startup the user can verify that successful USB communication has been established by selecting "Read All", the default programmed voltages should appear.

LDO's can be enabled and disabled by clicking mouse left button on the square close to each LDO voltage slider. Changing the virtual slider changes the LDO voltage. After the WRITE button is pressed subsequent LDO changes are applied if the 'autowrite' feature is disabled.

Note 'Autowrite' enabled is default. In the case of the buck control, an option for 'hold' or 'go' can be selected. Note voltage will not change until the 'go' selection is made.

The virtual voltmeters can be activated by selecting 'Poll Status', after which an A to D conversion is read and displayed for each subsequent LDO and Buck output. Note that this feature is meant to be a general measurement and "may" be subject to variations due to operations noise.

Since there is a bi-directional SDA feature, any register and its contents can be determined by entering the desired register address and selecting 'Read'. In addition, any corresponding register may be written directly to via the 'Store' selection. All virtual sliders can be updated via the 'Read All' Tab. Direct register control is possible by entering the desired address and value followed by a 'Store' command.

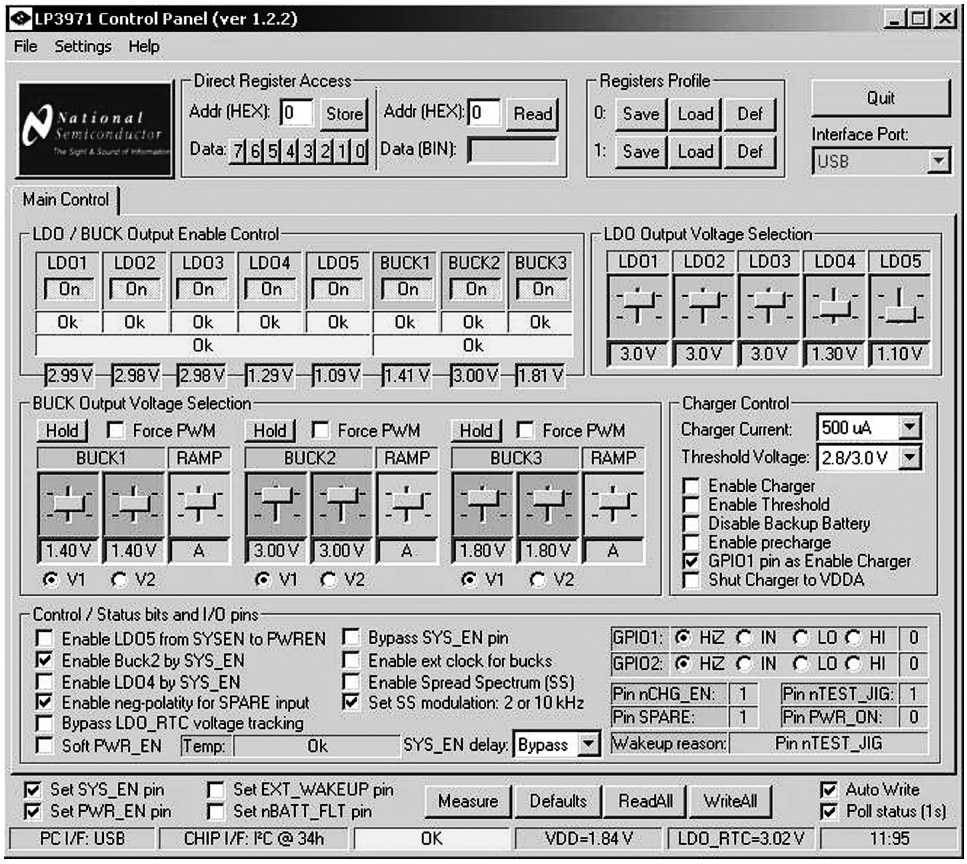

Figure 3. Control Panel

10 Layout Details

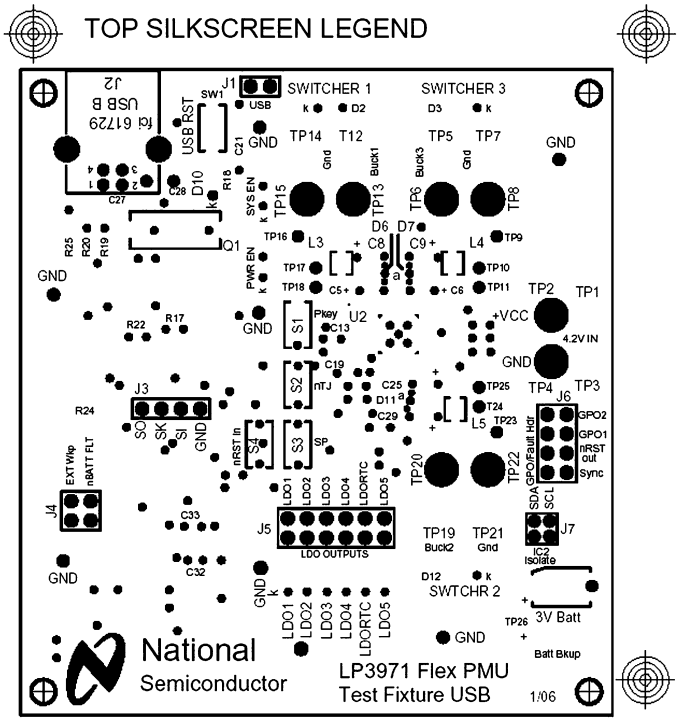

Figure 4. Top Silkscreen

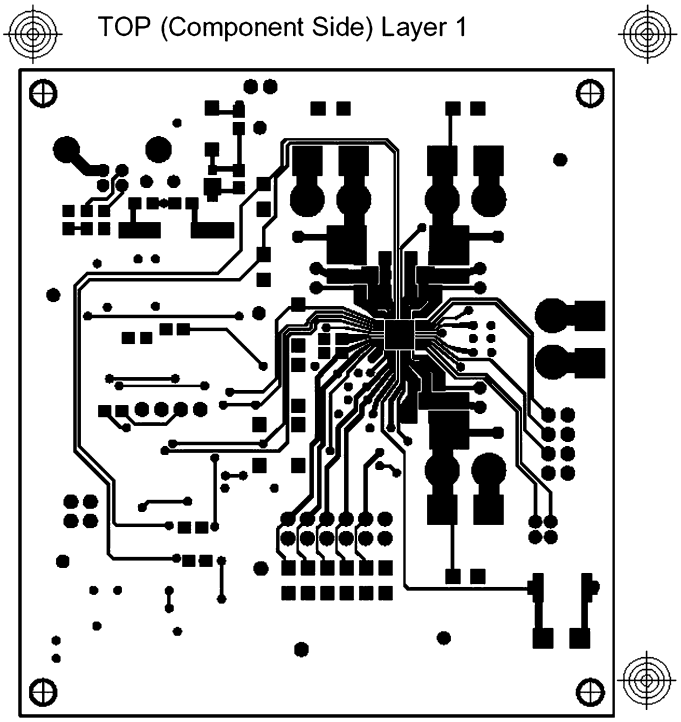

Figure 5. Top Trace

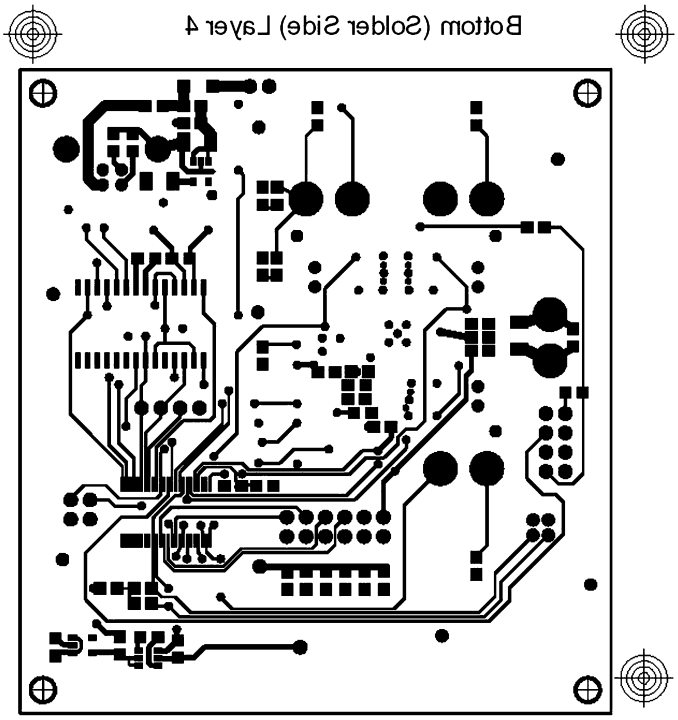

Figure 6. Bottom Trace

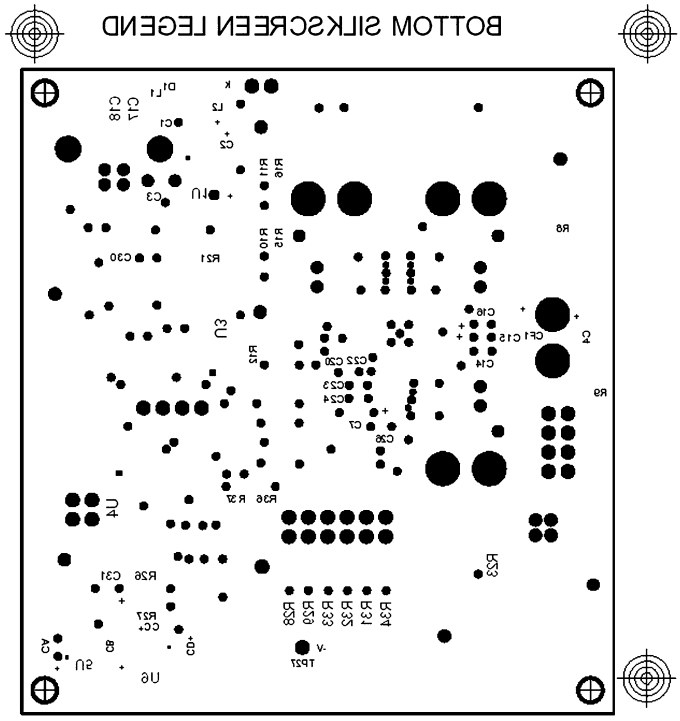

Figure 7. Bottom Silkscreen

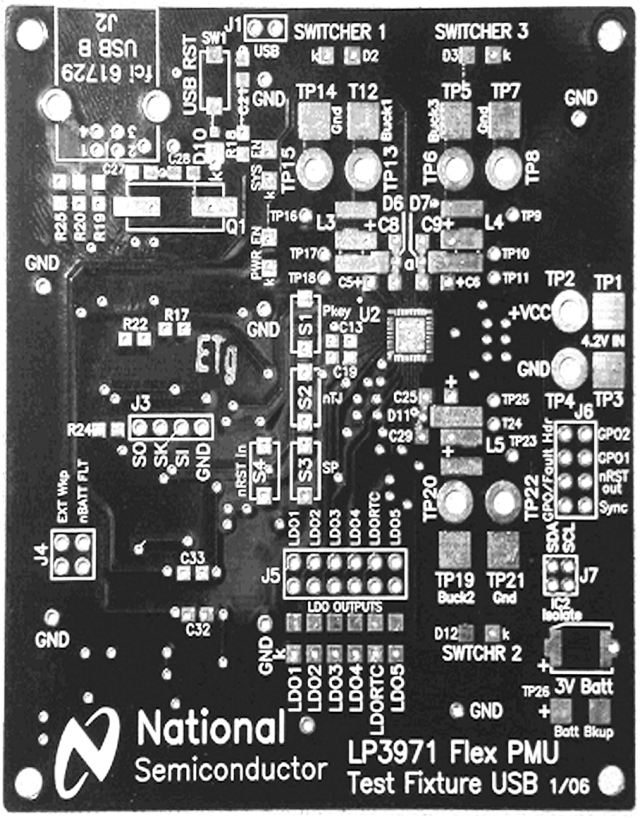

Figure 8. Bare Board/Component Locations

11 LP3971 Flex_PMU Evaluation Board Schematic

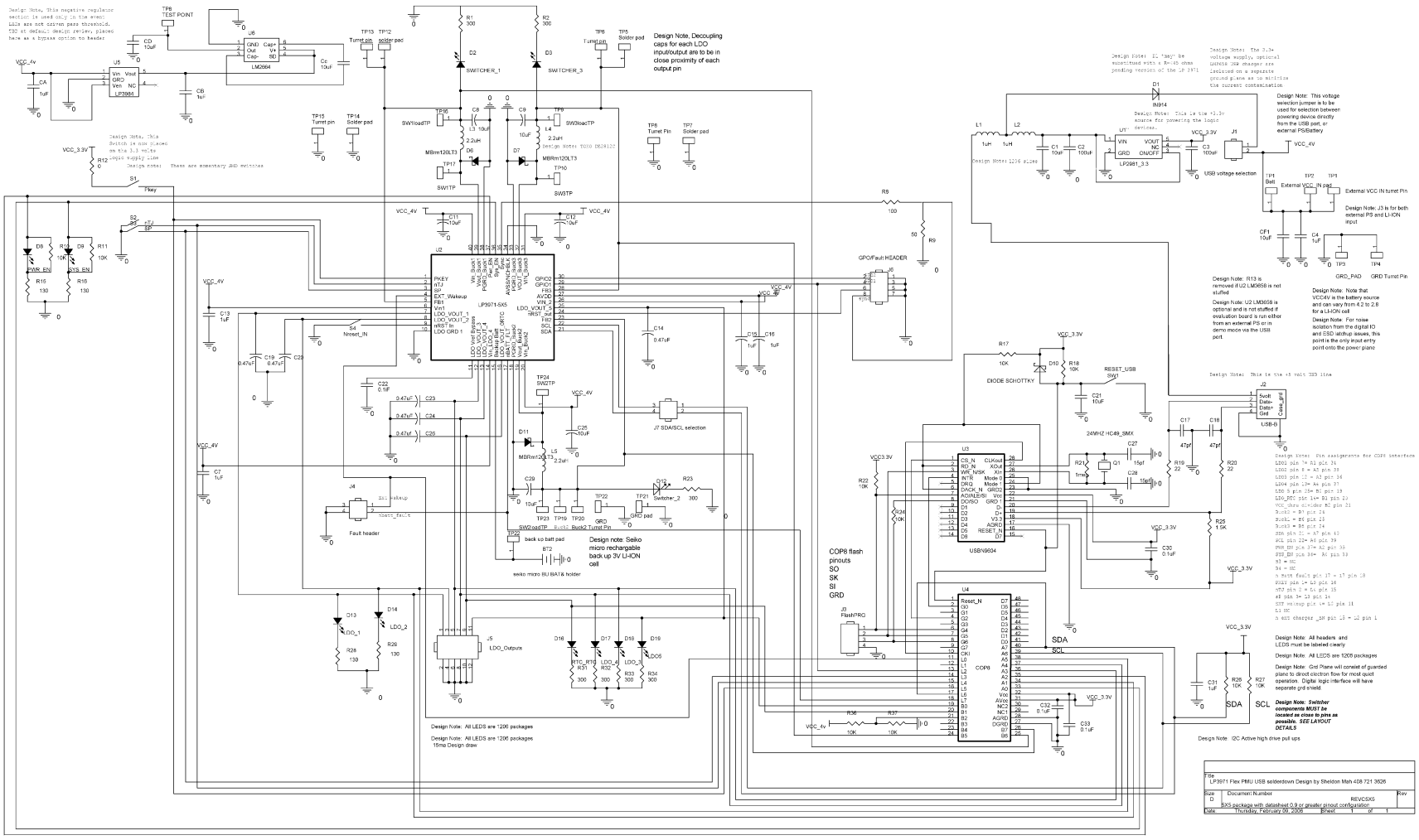

Figure 9. LP3971 Flex_PMU Evaluation Board Schematic

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