

ON Semiconductor

Is Now



To learn more about onsemi™, please visit our website at
www.onsemi.com

onsemi and onsemi. and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries. onsemi owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of onsemi product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. onsemi reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and onsemi makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using onsemi products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by onsemi. "Typical" parameters which may be provided in onsemi data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. onsemi does not convey any license under any of its intellectual property rights nor the rights of others. onsemi products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use onsemi products for any such unintended or unauthorized application, Buyer shall indemnify and hold onsemi and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that onsemi was negligent regarding the design or manufacture of the part. onsemi is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner. Other names and brands may be claimed as the property of others.



ON Semiconductor

DN05133/D

Design Note – DN05133/D

LiB Charge/Discharge Controller for Bicycle LED Light Systems

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
LC709301F	Bicycle LED Light	4.5 - 5.5	10 W	Charge/Discharge Controller	N/A

	Charge	Discharge
Output Voltage	4.2 V	4.2-5.0 V
Nominal Current	1000 mA	1000 mA
Max Current	2000 mA	2000 mA
Min Current	25 mA	25 mA

Device Efficiency	80 - 85 %
Operating Temp. Range	-40 to 85 °C
Overcharge/Discharge Protection	Yes
Pre-charge Control	Yes
Lib Protection	Yes
Low Battery Indication	Yes

Circuit Description

The LC709301F is a one-chip solution LSI with charging/discharging and overall control functions for bicycle LED lights. Included is a DC/DC charging system to charge high power lithium-ion batteries quickly and efficiently. Supported are 1-cell lithium-ion/polymer (li+) batteries with charging ranges from 25 mA to 2000 mA. The LC709301F is highly efficient for LED lighting operations with ultra-low stand-by current consumption. It includes various safety features for battery and LED such as over current/voltage protection, thermal shutdown. It supports high, medium, low and flashing modes of operation for LED design. Boost efficiency and standby current for the LC709301F is plotted below.

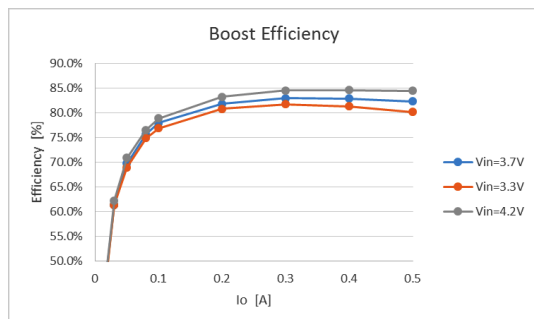


Figure 1: LC709301F boost efficiency based on battery capacity

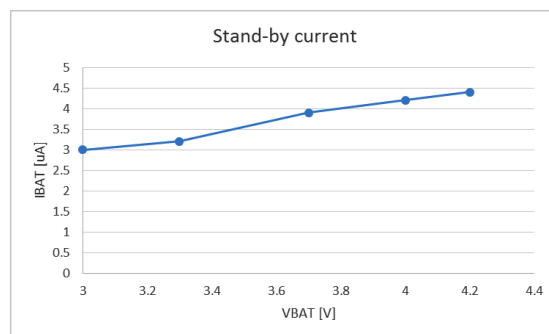


Figure 2: LC709301F standby current including Lib-protection IC

Key Features

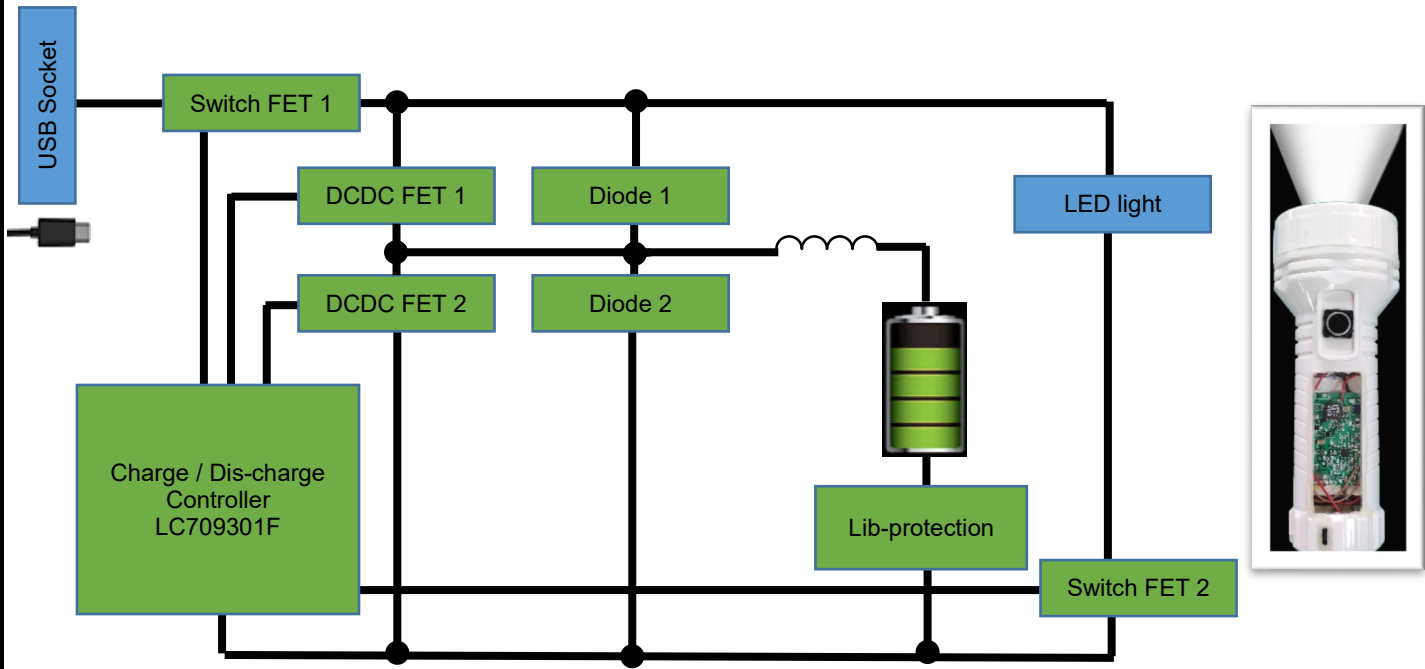
- DC-DC USB charging support up to 2000 mA range
- LED brightness remains constant even if battery voltage continuously degrades with long use
- Ultra-low standby current consumption
- Supports pass-through charge topology, DC5V output is directly powered via USB when wall power is connected
- Programmable MCU with I2C support
- MCU with on-chip thermistor for providing safety to LED and device

Schematic

(LEDHUGEVB with LC709301F)



DN05133/D



Switch MOSFETs

Function	Device	Configuration	Polarity	VDD _S Max (V)	VGSS Max (V)	ID Max (A)	RDS(ON) VGS = 4.5 V Typ/Max (mΩ)	RDS(ON) VGS = 10 V Typ/Max (mΩ)	Package
Switch FET 1 DCDC FET 1	MCH6341	Single	P-Channel	-30	/±20	5	71/100	45/59	MCPH6
Switch FET 2 DCDC FET 2	MCH6431	Single	N-Channel	30	/±20	5	65/91	42/55	MCPH6

Schottky Diodes

Family	VR (V)	IO (A)	Example Device	Packages
Schottky	10	2.0	MBRA210ET3	SMA
Schottky	20	1.0	MBR120ESF	SOD-123FL

Lib-protection

	Adjustable Range			VSSS Max /VGSS Max (V)	RSS(ON) VGS = 4.5 V Min/Typ/Max (mΩ)	RSS(ON) VGS = 3.1 V Min/Typ/Max (mΩ)	Features	Package(s)
	VOV Range (V)	VUV Range (V)	IOC/IOCH Range (A)					
LC05111CMT*	4.0 to 4.5	2.2 to 2.7	2 to 8	24/±12	8.8/11.2 /14.0	10.4/13.0 /18.2	Auto Wake-up, 0 V Charge	WDFN-6

DN05133/D

Bill of Materials

(LEDHLGEVB with LC709301F)

11/18/2019

Designator	Quantity	Description	Value	Tolerance	Footprint	Manufacturer	Manufacturer Part Number	Substitution Allowed	Lead Free
IC1	1	Charge/Discharge controller	–	–	VCT24	ON Semiconductor	LC709301FRF-AUNH	No	Yes
IC2	1	Lib-Protection	–	–	WDFN6	ON Semiconductor	LC05111CMTC20	No	Yes
U3, U4	2	Pch MOSFET	–	–	MCPH6	ON Semiconductor	MCH6341	No	Yes
U1, U2	2	Nch MOSFET	–	–	MCPH6	ON Semiconductor	MCH6341	No	Yes
D1	1	Schottky Diode	–	–		ON Semiconductor	MBRA210ET3	No	Yes
D2	1	Schottky Diode	–	–		ON Semiconductor	MBR120ESFT1G	No	Yes
D3	1	Zenner Diode	–	–		ON Semiconductor	MM525V6ST1G	No	Yes
D4	1	LED	Red	–	1608	Stanley	BR1111C	Yes	Yes
L1	1	Coil	10uH	–		WE	744314101	Yes	Yes
C1 C7, C8	3	Chip Capacitor	0.1u	50V, ±10%	CAP_1005	Murata	GRM155R71H104KE14D	Yes	Yes
C5	1	Chip Capacitor	0.1u	50V, ±10%	CAP_1608	Murata	GRM188F11H104ZA01D	Yes	Yes
C2	1	Chip Capacitor	DNP		CAP_1005	Murata		Yes	Yes
C6	1	Chip Capacitor	1000p	50V, ±10%	CAP_1005	Murata	GRM1552C1H102	Yes	Yes
C3, C4	2	Chip Capacitor	47u	16V, ±10%	CAP_3225	Murata	GRM32ER61C476KE15L	Yes	Yes
C9	1	Chip Capacitor	10u	25V, ±10%	CAP_3216	Murata	GRM31CB31E106KA75L	Yes	Yes
R1, R8–R10, R14, R17	6	Chip Resistor	100k	0.1W, ±1%	RES_1005	Rohm	MCR01MZPJ104	Yes	Yes
R12, R16, R18, R19	4	Chip Resistor	30k	0.1W, ±1%	RES_1005	KOA	RK73H1ETTP3002F	Yes	Yes
T2	1	Chip Resistor	47m	1W, ±1%	RES_3216	Panasonic	ERJ8BWF047V	Yes	Yes
R3–R6	4	Chip Resistor	2.2	1W, ±1%	RES_6432	Panasonic	ERJ1TRQF2R2U	Yes	Yes
R7, R11, R13, R25, R26	5	Chip Resistor	10k	0.1W, ±1%	RES_1005	Rohm	MCR01MRTJ103	Yes	Yes
R24	1	Chip Resistor	220k	0.1W, ±1%	RES_1005	KOA	ERJ2RKD2203X	Yes	Yes
R21	1	Chip Resistor	680	0.125W, ±5%	RES_1005	KOA	RK73B1ETTP681J	Yes	Yes
R20	1	Chip Resistor	1k	0.1W, ±5%	RES_1005	Murata	MCR01MZPJ102	Yes	Yes
R22, R23	2	Chip Resistor	5.1k	0.1W, ±5%	RES_1005	Rohm	RK73B1ETTP512J	Yes	Yes
R15	1	Chip Resistor	330	0.1W, ±5%	RES_1005	Rohm	MCR01MRTF3300	Yes	Yes
R2	1	Chip Resistor	0	–	RES_1005	Rohm	MCR01MRTJ000	Yes	Yes
S1	1	TACT SWITCH	–	–	–	ALPS	SKRPACE010	Yes	Yes
T1	1	Thermistor	10k	–	–	Murata	NXFT15XH103FA2B050	Yes	Yes
J1	1	3pin Connector	–	–	–	JAE	IL-G-3P-S3T-SA	Yes	Yes
J2	1	USB_TYPE-C	–	–	–	RoHs	DX07S024JJ2	Yes	Yes
TEST PADS	27	Testpads			PIN_1.5X1.5MM	N/A	N/A		
							IL-G-3P-S3T2-SA		

© 2019, SCILLC.

Disclaimer: Semiconductor Components Industries, LLC (SCILLC) dba ON Semiconductor is providing this design note “AS IS” and does not assume any liability arising from its use; nor does SCILLC convey any license to its or any third party’s intellectual property rights. This document is provided only to assist customers in evaluation of the referenced circuit implementation and the recipient assumes all liability and risk associated with its use, including, but not limited to, compliance with all regulatory standards. SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages.