



ON Semiconductor

# LiB Charge/Discharge Controller for Charging Cradle Systems

Device	Application	Input Voltage	Output Power	Topology	I/O Isolation
LC709301F	Charging Cradle	4.5 - 5.5	2.5 W	Charge/Discharge Controller	N/A

	Charge	Discharge
Output Voltage	4.2 V	5 V
Nominal Current	100 mA	100 mA
Max Current	500 mA	500 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 charge/discharge control system for charging cradles. It supports linear charging systems for 1-cell lithium-ion/polymer (li+) batteries within a range of 25 mA to 500 mA. Battery power while discharging is reversed, and the LC709301F operates as a boost converter while charging devices. It provides one-chip solution with charging/discharging and system control for cradle charging. This note is intended for users designing charge/discharge systems for end products such as ear-buds, smartwatch, portable speaker etc. The boost efficiency and standby current for LC709301F is plotted below.

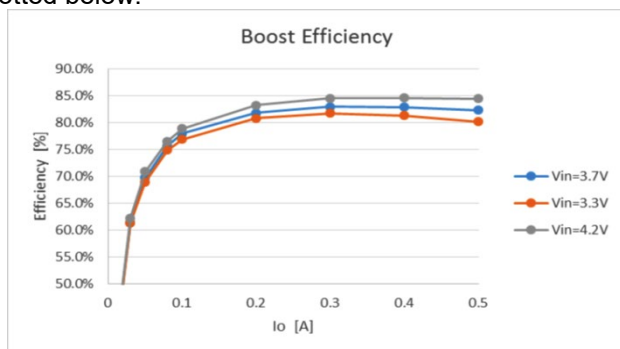


Figure 1: LC709301F boost efficiency based on battery capacity

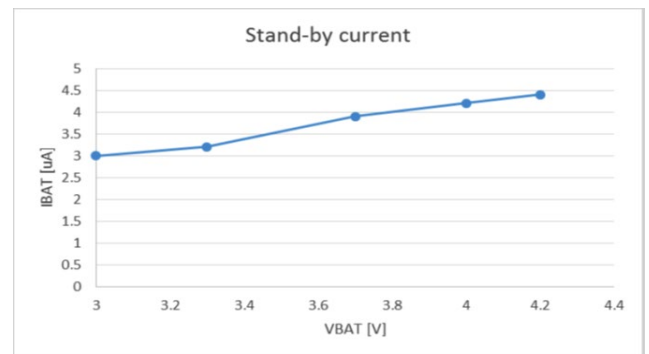


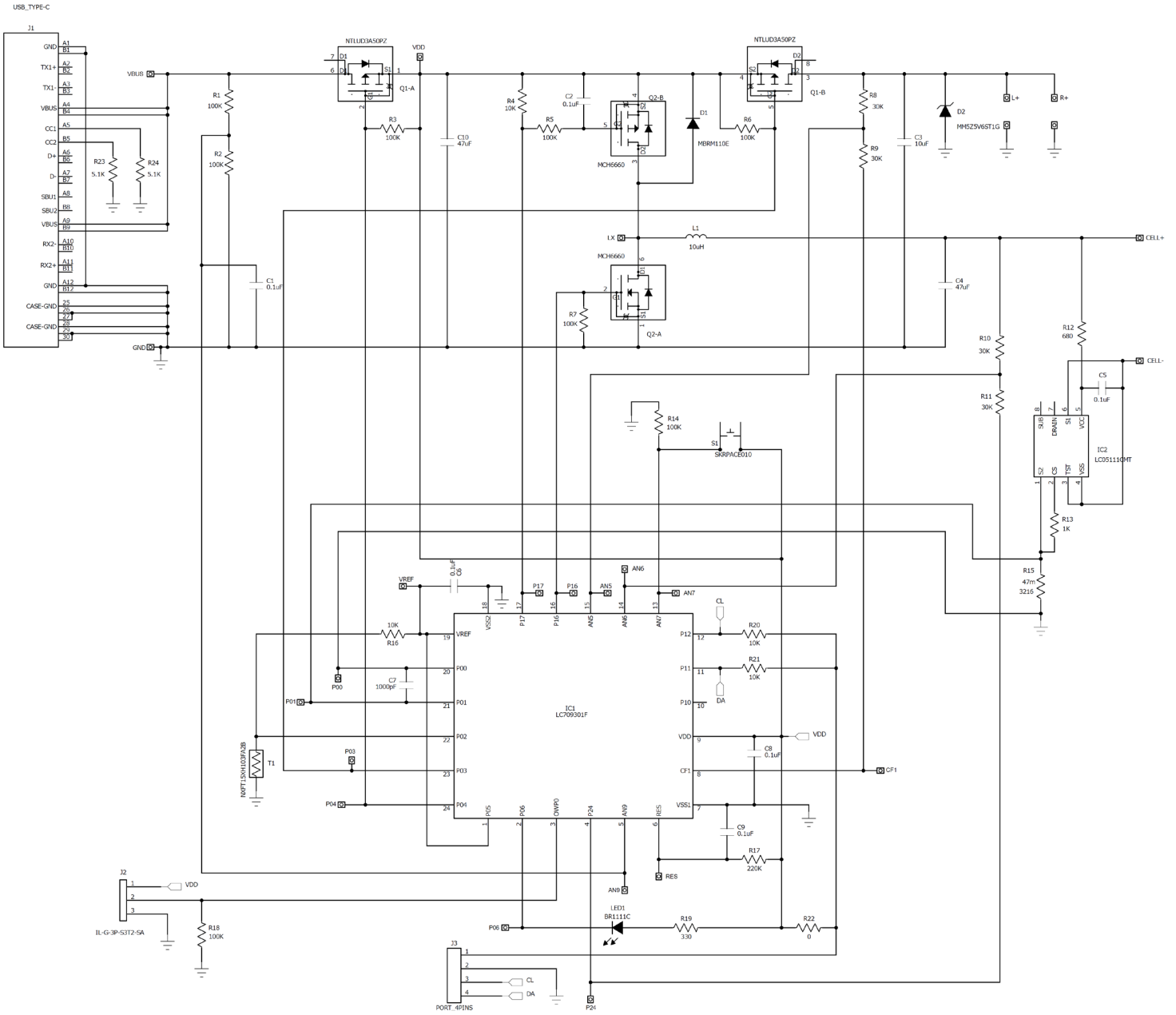
Figure 2: LC709301F standby current including Lib-protection IC

## Key Features

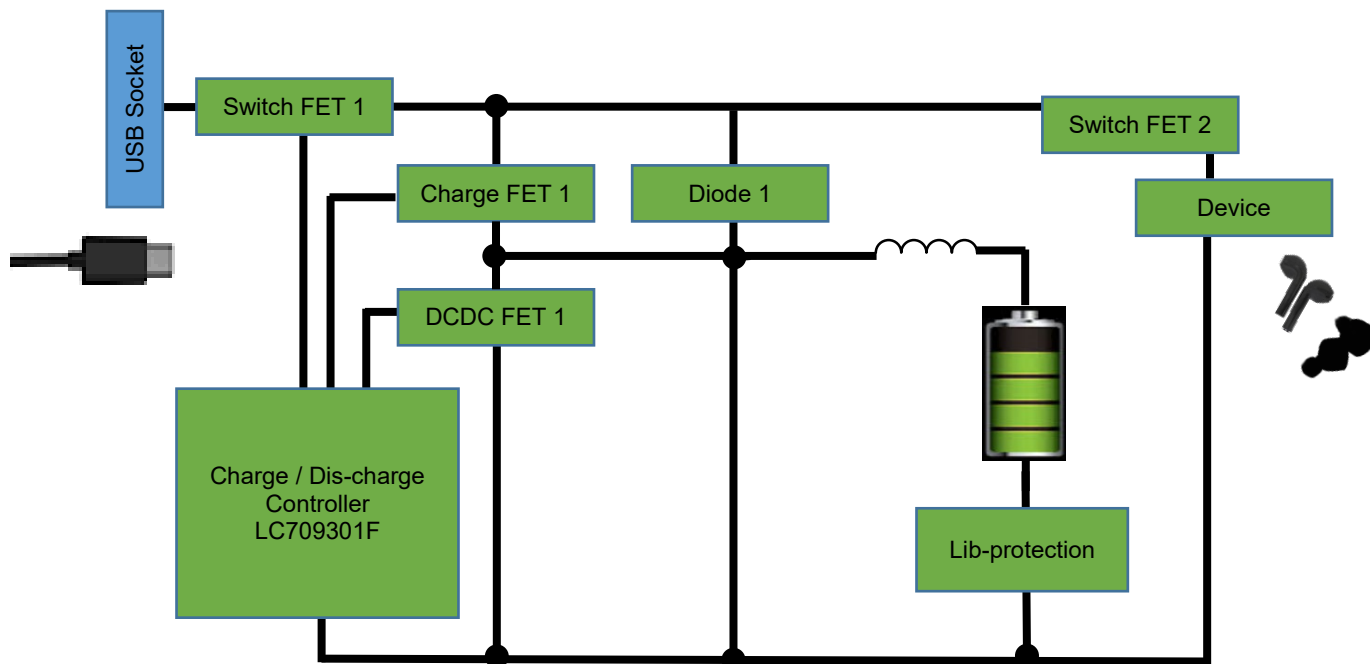
- Supports linear charge control DC5V(USB) up to 500 mA
- Supports pass-through charge topology, DC5V output is directly powered via USB when wall power is connected
- Ultra-low stand-by current consumption
- Programmable MCU with I2C support
- MCU with on-chip thermistor for providing safety to load and device
- Supports external thermistor for measuring battery temperature.

# DN05132/D

## Schematic (CRADLE1GEVB with LC709301F)



## DN05132/D



### Switch MOSFETs

Function	Device	Configuration	Polarity	V <sub>DD</sub> S Max (V)	V <sub>G</sub> SS Max (V)	I <sub>D</sub> Max (A)	R <sub>DS(ON)</sub> V <sub>G</sub> S = 4.5 V Typ/Max (mΩ)	Package
Switch FET 1 Switch FET 2	NTLUD3A50PZ	Dual	P-Channel	-20	/±8	5.6	37/50	UDFN6
Charge FET 1 DCDC FET 2	MCH6660	Dual	N-Channel P-Channel	20 -20	/±10 /±10	2 1.5	105/136 205/266	MCPH6

### Schottky Diodes

Family	V <sub>R</sub> (V)	I <sub>O</sub> (A)	Example Device	Packages
Schottky	10	1.0	MBRM110E	POWERMITE (CASE 457-04)

### Lib-protection

	Adjustable Range			V <sub>SS</sub> Max /V <sub>G</sub> SS Max (V)	R <sub>DS(ON)</sub> V <sub>G</sub> S = 4.5 V Min/Typ/M ax (mΩ)	R <sub>DS(ON)</sub> V <sub>G</sub> S = 3.1 V Min/Typ/M ax (mΩ)	Features	Package(s)
	V <sub>OV</sub> Range (V)	V <sub>UV</sub> Range (V)	I <sub>OC</sub> /I <sub>OCH</sub> Range (A)					
LC05111CM T*	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

## DN05132/D

## Bill of Materials

(CRADLE1GEVB 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-AUMH	No	Yes
IC2	1	Lib-Protection	-	-	WDFN6	ON Semiconductor	LC05111CMTC20	No	Yes
Q1	1	Pch MOSFET	-	-	UDFN6	ON Semiconductor	NTLUD3A50PZ	No	Yes
Q2	1	Pch Nch MOSFET	-	-	MCPH6	ON Semiconductor	MCH6660	No	Yes
D1	1	Schottky diode	-	-	CASE457	ON Semiconductor	MBRM110ET1G	No	Yes
D2	1	Zener diode	-	-	SOD-523	ON Semiconductor	MM5Z5V6ST1G	No	Yes
L1	1	Inductor	10u	-	-	WE	74404042100	Yes	Yes
LED1	1	LED	Red	-	1608	Stanley	BR1111C	Yes	Yes
C1, C2, C5, C6, C8, C9	6	Chip Capacitor	0.1u	25V, ±10%	CAP_1608	Murata	GRM188B11E104KA01D	Yes	Yes
C7	1	Chip Capacitor	1000p	50V, ±10%	CAP_1608	Murata	GRM188B11H102KA01D	Yes	Yes
C3	1	Chip Capacitor	10u	25V, ±10%	CAP_3216	Murata	GRM31CB31E106KA75L	Yes	Yes
C4, C10	2	Chip Capacitor	47u	16V, ±10%	CAP_3225	Murata	GRM32ER61C476KE15L	Yes	Yes
R1-R3, R5-R7, R14, R18	8	Chip Resistor	100k	0.1W, ±1%	RES_1608	Rohm	MCR03EZPFX1003	Yes	Yes
R8-R11	4	Chip Resistor	30k	0.1W, ±1%	RES_1608	KOA	RK73H1JTDD3002F	Yes	Yes
R15	1	Chip Resistor	47m	1W, ±1%	RES_3216	Panasonic	ERJ8BWR047V	Yes	Yes
R4, R16, R20, R21	4	Chip Resistor	10k	0.1W, ±1%	RES_1608	Rohm	MCR03EZPFX1002	Yes	Yes
R17	1	Chip Resistor	220k	0.1W, ±1%	RES_1608	KOA	RK73H1JTDD2203F	Yes	Yes
R12	1	Chip Resistor	680	0.125W, ±5%	RES_1608	KOA	RK73B1JTDD681J	Yes	Yes
R13	1	Chip Resistor	1k	0.1W, ±5%	RES_1608	Rohm	MCR03EZPJ102	Yes	Yes
R19	1	Chip Resistor	330	0.1W, ±5%	RES_1608	Rohm	MCR03EZPFX3300	Yes	Yes
R22	1	Chip Resistor	0	-	RES_1608	KOA	RK73Z1JTDD	Yes	Yes
S1	1	TACT SWITCH	-	-	-	ALPS	SKRSPACE010	Yes	Yes
T1	1	Thermistor	10k	-	-	Murata	NXFT15XH103FA2B050	Yes	Yes
J1	1	Connector	-	-	-	JAE	USB Type-C	Yes	Yes
J2	1	Connector	-	-	-	JAE	IL-G-3P-S3T2-SA	Yes	Yes
J3	1	Connector	-	-	-	-	-	Yes	Yes
R23-24	1	Chip Resistor	5.1k	-	RES_1608	-	-	Yes	Yes

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