LTC4123EDC
Low Power Wireless Charger Demonstration Kit

DESCRIPTION

Demonstration Circuit DC2302A is a kit of the DC2300A demonstration board, featuring the LTC®4123EDC, and the DC2301A Single Switch Transmitter demonstration board. The DC2300A can charge a single NiMH battery at up to 25mA, with an air gap of 0.8mm to 4.0mm. The DC2300A detects Zinc-Air primary cells and will not charge them.

Design files for this circuit board are available at http://www.linear.com/demo/DC2302A

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PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{IN}	DC2301A Voltage Input	$I_{VIN} \leq 0.5A$	4.5		5.5	V
I_{BAT}	DC2300A Battery Charger Current	V_{CC} = 3V ~ 5V, DC2300A.R1 = 953Ω	24		26	mA

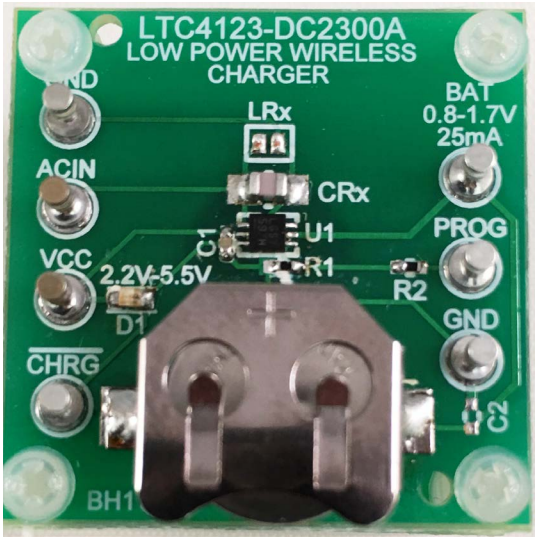


Figure 1. Demonstration Kit with Battery

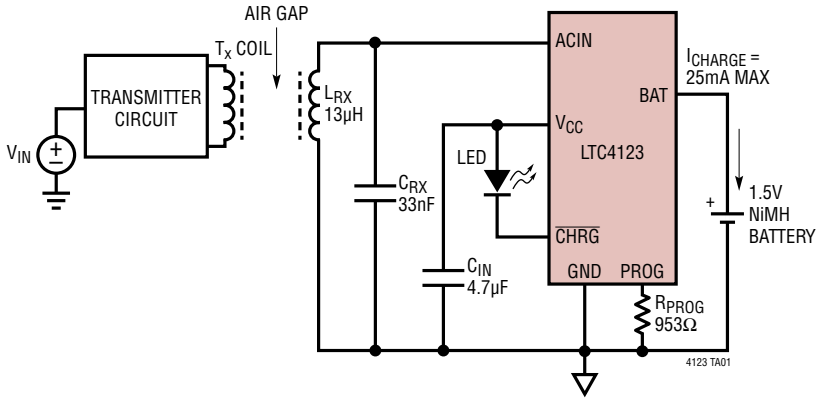


Figure 2. Typical Application Circuit

DEMO BOARD PROCEDURE

Refer to Figure 5 for the proper measurement equipment setup and follow the procedure below:

NOTE: When measuring the input or output voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across the signal and GND terminals. See Figure 6 for proper scope probe technique.

1. Set PS1 to 1.3V and turn on.
2. Plug a Micro-USB cable into DC2301.J1, the other end of the cable should go to a computer USB port or a 5V wall charger.
3. Verify that DC2301A.D1 is lit. DC2301A.D1 is between the boards, near the front face.
4. The LTC4123EDC spends the first 90s after power up testing for either a reverse battery or a Zinc-Air primary battery. DC2300A.D1 should be blinking slowly. AM1should read 25mA. VM1 should read between 3V and 5V.

   The LTC4123EDC tests for a Zinc-Air battery by applying the programmed charge current, and checking to see if V(BAT) rises above ≈ 1.65V.

   If the battery is absent, reversed or Zinc-Air, DC2300A. D1 will start blinking rapidly.
5. Turn off and disconnect PS1, AM1 and VM1. Install the P675 NiMH battery in the DC2300A.BH1 battery holder. See Figure 4 for proper insertion. Warning: improper insertion may short battery.



(a) DC2300A Top



(b) DC2301A Top



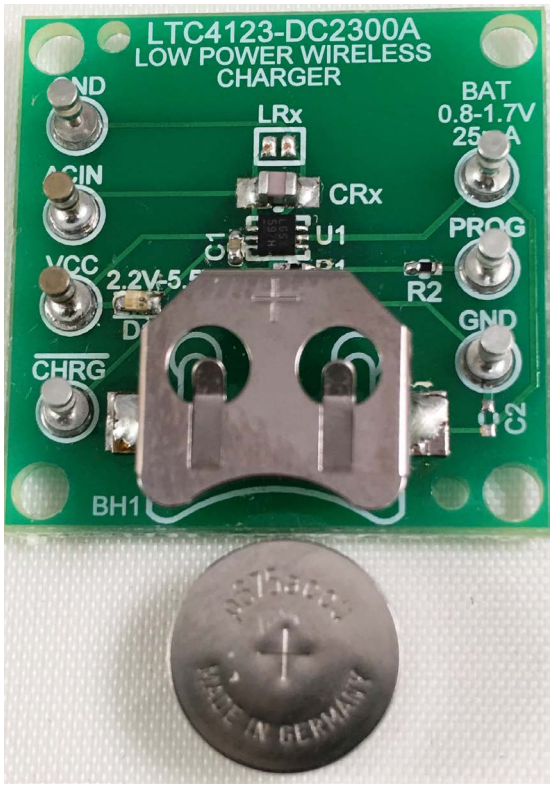
(c) DC2300A Bottom



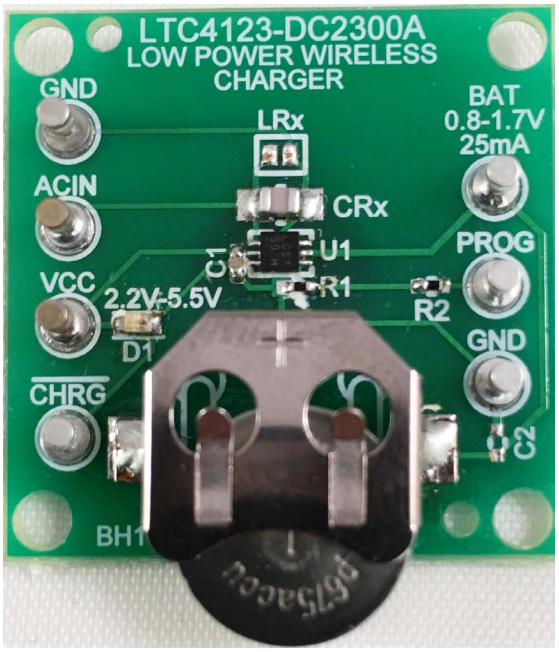
(d) DC2301A Bottom

Figure 3. DC2300A and DC2301A Demo Boards

DEMO BOARD PROCEDURE



(a)



(b)



(c)

Figure 4. Proper Insertion of Battery in Demo Kit

DEMO BOARD PROCEDURE

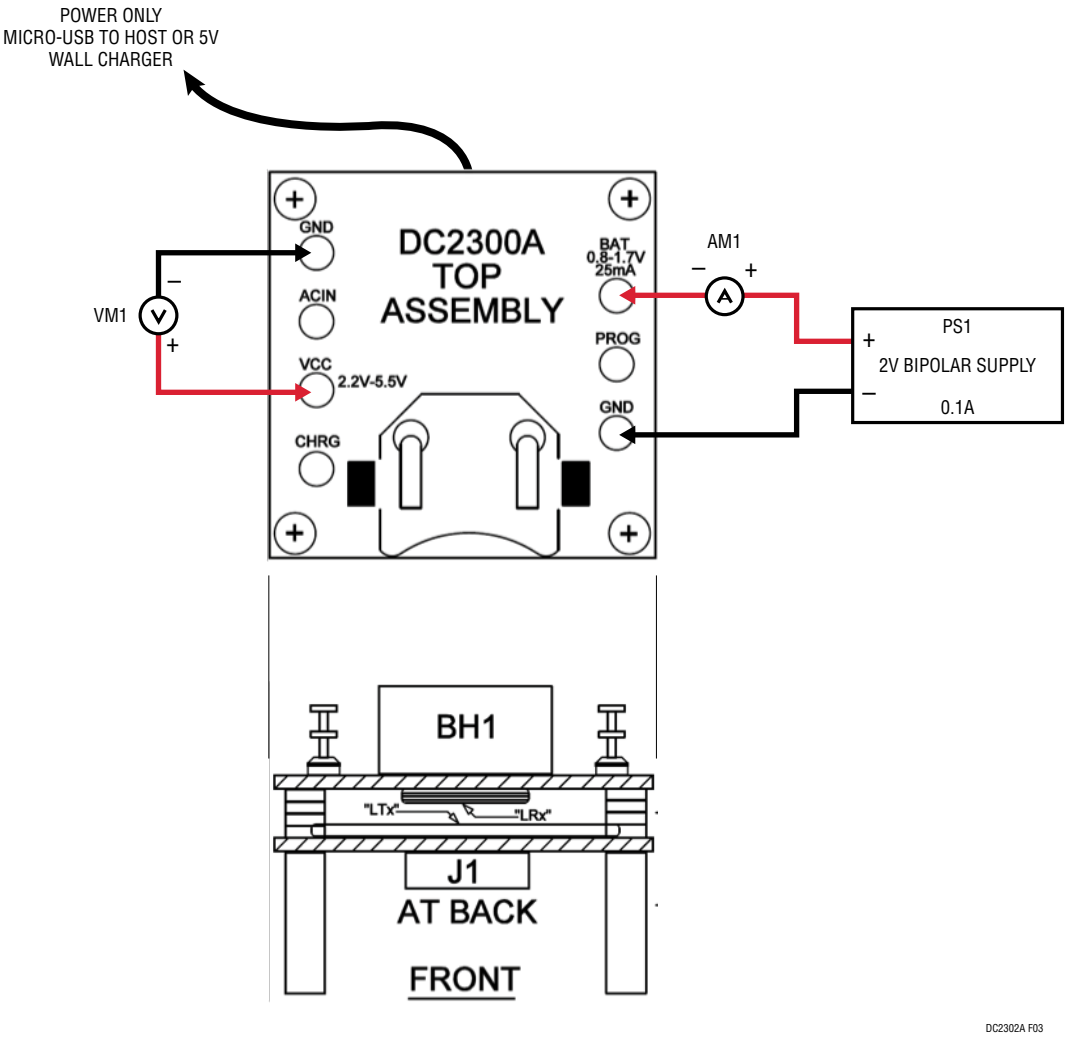


Figure 5. DC2300A Mounted on Top of DC2301A

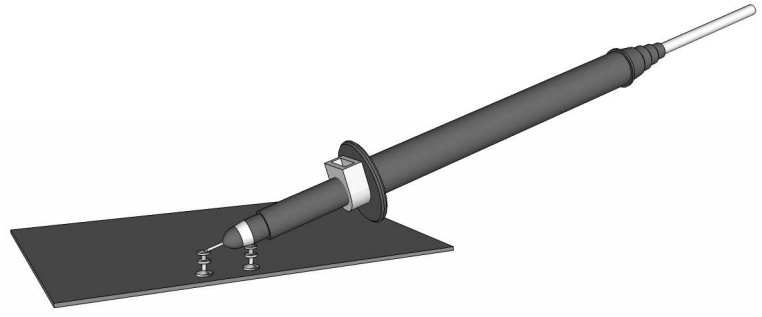


Figure 6. Measuring Input or Output Ripple

Note: All connections from equipment should be Kelvin connected directly to the board pins which they are connected on this diagram and any input or output leads should be twisted pair.

THEORY OF OPERATION

The DC2302A kit demonstrates operation of the LTC4123EDC Low Power Wireless Charger. The kit is composed of the DC2300A Wireless Power Transfer (WPT) receiver and the DC2301A WPT transmitter.

DC2300A – Low Power Battery Charger Board Featuring the LTC4123EDC

The LTC4123EDC integrates a low power CC-CV linear charger optimized for NiMH cells. The LTC4123EDC also contains a low leakage diode for rectifying the output of the WPT resonant tank. The DC2300A WPT resonant tank is set to 244kHz. Tested receive coils are listed in Table 1.

The CC-CV charger will operate with a V_{CC} as low as 2.2V, and charge a NiMH battery to 1.61V (T_A = –10°C). The Charge Voltage is temperature dependent, a temperature coefficient of –2.5mV/°C, and a typical charge voltage of 1.5075, at room (see Figure 7).

The LTC4123EDC has a fault state machine that checks for battery reversal and presence of a Zinc-Air primary cell in the first 90s after V_{CC} is applied.

The LTC4123EDC has an on-die temperature sensing that will shut down the charger if the sensed temperature is too high or low.

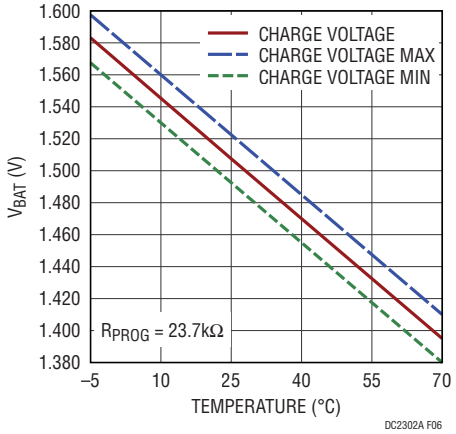


Figure 7. Charge Voltage vs Temperature (Placeholder)

The WPT for the LTC4123EDC is implemented as resonant power transfer, with the LTC4123EDC rectifying the resonant tank voltage to generate V_{CC} (see Figure 9).

DC2301A – Wireless Power Transmitter Board Featuring the LTC6990IDCB

The DC2301A is a wireless power transmitter board using an LTC6990IDCB TimerBlox®, followed by a zero voltage switching Class C amplifier.

The LTC6990IDCB is programmed to generate a 244kHz square wave, but the Class C amplifier tank is resonant at 315kHz, resulting in zero voltage switching (see Figure 8). Tested transmit coils are listed in Table 2.

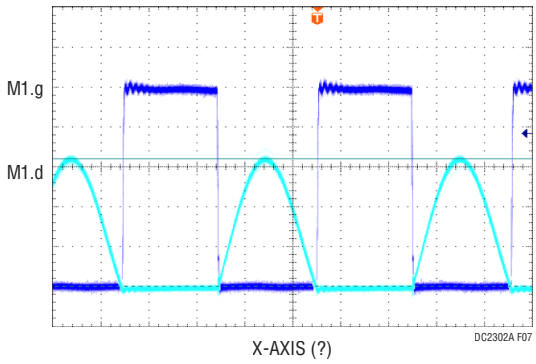


Figure 8. DC2301A V_{IN} = 5V, Air Gap = 4mm

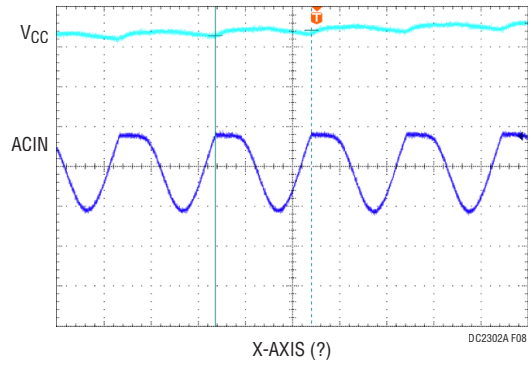


Figure 9. DC2300A V_{IN} = 5V, Air Gap = 4mm

THEORY OF OPERATION

Operating the DC2302A WPT Kit from a USB Port

The DC2302A WPT Demo Kit to can comply with the requirements for a USB peripheral. One requirement is the 50µC inrush charge specification, which drives the maximum input capacitance. Another requirement is that a USB peripheral must draw less than 100mA, until negotiating for more. The DC2302A WPT kit does not contain a microcontroller to negotiate for more than 100mA, so, it must operate at less than 100mA.

DC2301A.C2 can be changed to 4.7µF, which in parallel with DC2301A.C1 = 4.7µF, will be less than the 10µF. The DC2302A will then meet the 50µC inrush charge specification.

All air gaps mentioned below are the coil face to coil face distances:

0.8mm gap:	USB.V_{CC} current = 102mA @ USB.V_{CC} = 4.5 ~ 5.5V 300mV of 255kHz ripple on USB.V_{CC} DC2300A.V(BAT) = 1 ~ 1.4V
2.4mm gap:	USB.V_{CC} current = 84mA @ USB.V_{CC} = 4.5 ~ 5.5V 280mV of 255kHz ripple on USB.Vcc DC2300A.V(BAT) = 1 ~ 1.4V
4.0mm gap:	USB.V_{CC} current = 73mA @ USB.V_{CC} = 4.5 ~ 5.5V 240mV of 255kHz ripple on USB.Vcc DC2300A.V(BAT) = 1 ~ 1.4V

So, if the gap is kept greater than ≈ 1.5mm and DC2301A.C2 ≤ 4.7µF, the DC2302A should meet the compliance requirements for a USB peripheral. The DC2302A will not support suspend mode operation.

PARTS LIST

Table 1. Tested LRx Coils

Vendor	Part number	URL
Wurth	760308101208	http://www.we-online.com
Inter-Technical	L4120R19	http://www.inter-technical.com/index.php?page=products#
Sunlord	SWA12R10H17C01B	http://www.sunlordinc.com/

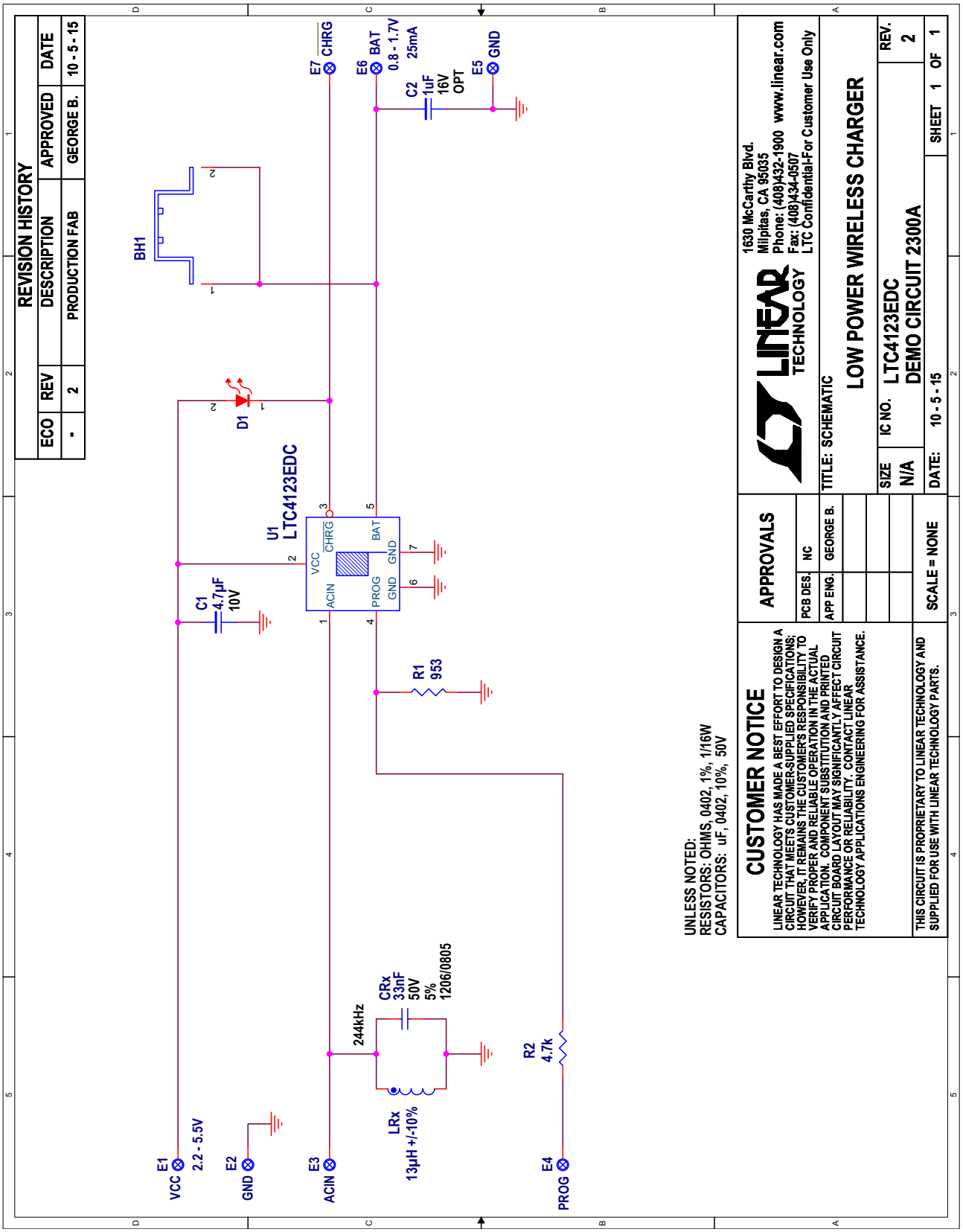
Table 2. Tested LTx Coils

Vendor	Part number	URL
Wurth	760308103206	http://www.we-online.com
Inter-Technical	L41200T23	http://www.inter-technical.com/index.php?page=products#
Sunlord	SWA28R15H08C01B	http://www.sunlordinc.com/

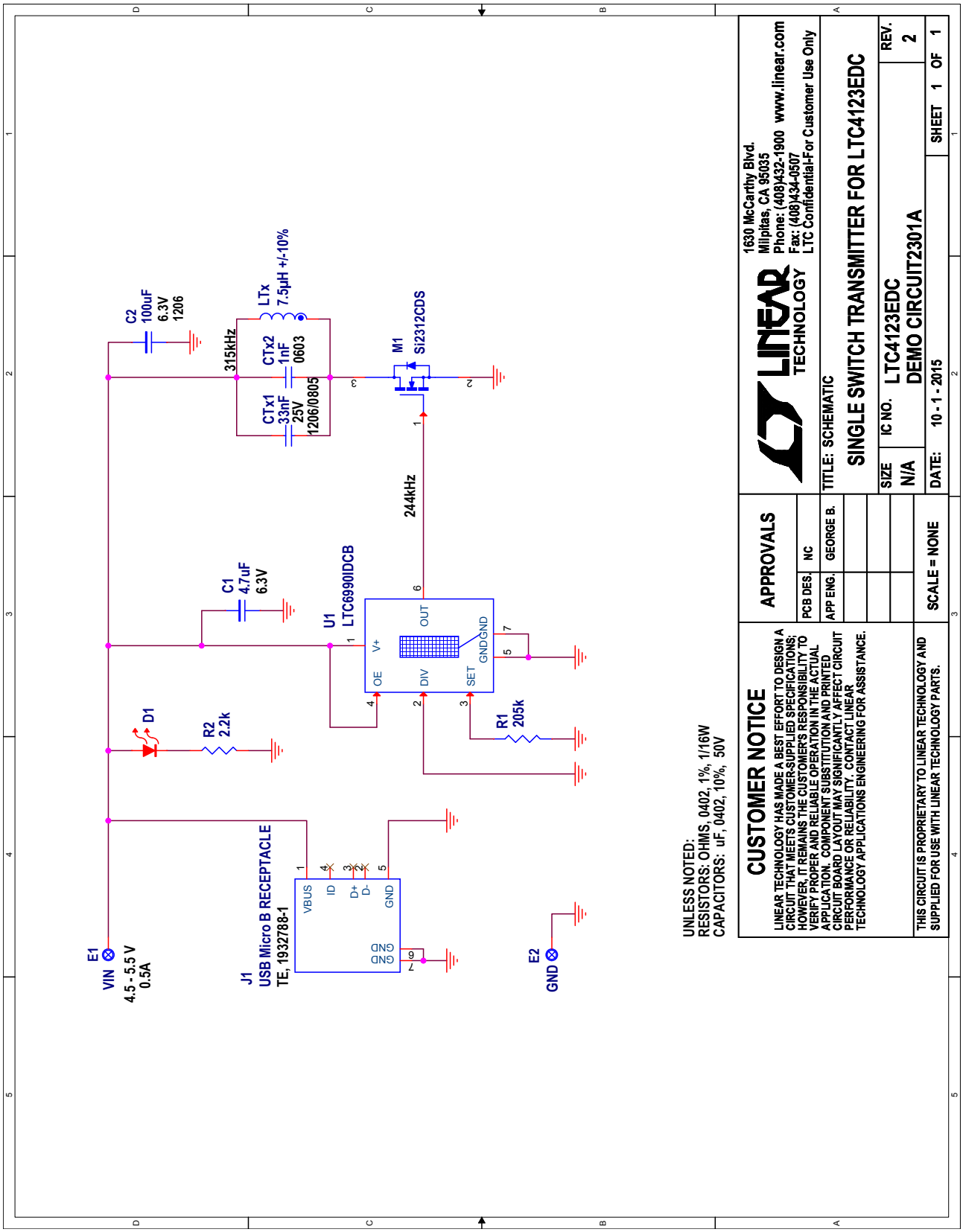
PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
			DC2300A	
Required Circuit Components				
1	1	C1	CAP, CHIP, X5R, 4.7µF, ±10%, 10V, 0402	SAMSUNG, CL05A475KP5NRNC
2	1	CRx	CAP, CHIP, C0G, 33nF, ±5%, 50V, 1206/0805	TDK, C2012C0G1H333J125AA
4	1	LRx	RECEIVE ANTENNA, 13µH, ±10%, 10mm	WURTH, 760308101208
5	1	R1	RES, CHIP, 953Ω, ±1%, 1/16W, 0402	VISHAY, CRCW0402953RFKED
6	1	U1	LOW POWER WIRELESS CHARGER, 2mm × 2mm DFN6	LINEAR TECH., LTC4123EDC
Additional Demo Board Circuit Components				
1	0	C2-OPT	CAP, CHIP, X5R, 1µF, ±10%, 16V, 0402	TDK, C1005X5R1C105K
2	1	D1	LED, RED, SMT, 0603	ROHM, SML-311UTT86
3	1	R2	RES, CHIP, 4.7kΩ, ±5%, 1/16W, 0402	VISHAY, CRCW04024K70JNED
Hardware: For Demo Board Only				
1	1	BH1	COIN CELL BATTERY RETAINER, 11.6mm	KEYSTONE, 2996
2	7	E1, E2, E3, E4, E5, E6, E7	TURRET, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0
			DC2301A	
Required Circuit Components				
1	1	C2	CAP, CHIP, X5R,100µF, ±20%,6.3V,1206	MURATA, GRM31CR60J107ME39L
2	1	CTx1	CAP, CHIP, C0G, 33nF, ±1%, 25V, 1206/0805	KEMET, C0805C333F3GACTU
3	1	CTx2	CAP, CHIP, C0G, 1nF, ±5%, 50V, 0603	TDK, C1608C0G1H102J080AA
4	1	LTx	TRANSMIT ANTENNA, 7.5µH, ±10%, 28mm × 15mm	WURTH, 760308103206
5	1	M1	MOSFET, N-CH 20V, 6A, SOT23-3	VISHAY, SI2312CDS-T1-GE3
6	1	R1	RES, CHIP, 205kΩ, ±1%, 1/16W, 0402	VISHAY, CRCW0402357KFKED
7	1	U1	TimerBlox: VOLTAGE CONTROLLED SILICON OSCILLATOR, 2mm × 3mm DFN6	LINEAR TECH., LTC6990IDCB
Additional Demo Board Circuit Components				
1	1	C1	CAP, CHIP, X5R, 4.7µF, ±20%, 6.3V, 0402	TDK, C1005X5R0J475M
2	1	D1	LED, RED, SMT, 0603	LITEON, LTST-C193KRKT-5A
3	1	J1	USB2.0 MICRO-B RECEPTACLE, RT, REVERSED, 1932788-1	TE, 1932788-1
4	1	R2	RES, CHIP, 2.2kΩ, ±5%, 1/16W, 0402	VISHAY, CRCW04022K20JNED
Hardware: For Demo Board Only				
1	2	E1, E2	TURRET, 0.061"	MILL-MAX, 2308-2-00-80-00-00-07-0

SCHEMATIC DIAGRAM



SCHEMATIC DIAGRAM



Information furnished by Linear Technology Corporation is believed to be accurate and reliable. However, no responsibility is assumed for its use. Linear Technology Corporation makes no representation that the interconnection of its circuits as described herein will not infringe on existing patent rights.

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This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a LTC application engineer.

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