LTM2894
7.5kV$_{RMS}$ Isolated USB Data Transceiver

DESCRIPTION

Demonstration circuit 2438A is an isolated USB data transceiver featuring the LTM®2894. The demo circuit features an EMI optimized circuit configuration, including an isolated DC-DC converter, and printed circuit board layout. All components for data signaling and isolation are integrated into the LTM2894 using LTC's isolator µModule® technology. The demo circuit operates from a supply on V_{CC} and/or V_{BUS}. The DC-DC converter generates an unregulated isolated output voltage on V_{CC2} and regulated 5V for USB communication on V_{BUS2}.

Design files for this circuit board are available at http://www.linear.com/demo/DC2438A

PERFORMANCE SUMMARY

Specifications are at T_A = 25°C

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC}	Operating Supply Range (Isolated Power Input)		4.4	6	45	V
V_{BUS}	Operating Supply Range (USB Bus Power Input)		4.4	5	5.5	V
V_{CC2}	Input Operating Range (DC-DC Off) V_{CC} Input Operating Range (DC-DC On) Output Voltage	 V_{BUS} = 4.4V, I_{CC2} = 200mA V_{CC} = 6V, I_{CC2} = 500mA	6 4.4	 5.5 5.5	45 7.5	V V V V
t_{LDR}	Low Speed Data Rate			1.5		Mbps
t_{FDR}	Full Speed Data Rate			12		Mbps
V_{IORM}	Maximum Working Insulation Voltage	GND to GND2	1414 1000			V_{DC} V_{RMS}
	Common Mode Transient Immunity		50			kV/µs

OPERATING PRINCIPLES

The LTM2894 demo board includes an isolated DC-DC converter delivering power to V_{CC2} at approximately 6V from the input supply V_{CC} and/or V_{BUS}. Isolation is maintained by the separation of GND and GND2 where significant operating voltages and transients can exist without affecting the operation of the LTM2894. The logic side is enabled upon connection of a USB cable via the LTM2894 ON pin. All logic side signals are referenced to the logic supply pin V_{LO}. The LTM2894 has two power supply inputs, V_{CC} and V_{BUS}. For applications requiring more than 200mA from V_{CC2}, V_{CC} must be connected to an external supply of 6V to 7V. V_{BUS} may be connected to USB bus power to enable data communication. If the isolated DC-DC converter is not needed then V_{CC2} may be driven by an external voltage.

Upstream USB signaling is controlled by the bidirectional pins $D1^+$ and $D1^-$. A 1.5k pull-up resistor is automatically configured dependent upon the connected downstream peripheral device. For full speed operation a 1.5k pull-up is asserted on $D1^+$, for low speed mode on $D1^-$. The downstream USB data pins, $D2^+$ and $D2^-$, each have integrated 15k pull-down resistors.

OPERATING PRINCIPLES

The demo circuit has been designed and optimized for low RF emissions. EMI mitigation techniques used include the following:

1. Board/ground plane size has been minimized. This reduces the dipole antenna formed between the logic side and isolated side ground planes.
2. Top signal routing and ground floods have been optimized to reduce signal loops, minimizing differential mode radiation.
3. The DC-DC converter uses a cascaded transformer arrangement, where the first transformer's isolated side center tap is connected to logic side ground. This effectively returns all common mode currents generated by the switching converter edge rate and transformer parasitic capacitance.

EMI performance is shown in Figure 1, measured using a gigahertz transverse electromagnetic (GTEM) cell and method detailed in IEC 61000-4-20, "Testing and Measurement Techniques – Emission and Immunity Testing in Transverse Electromagnetic Waveguides".

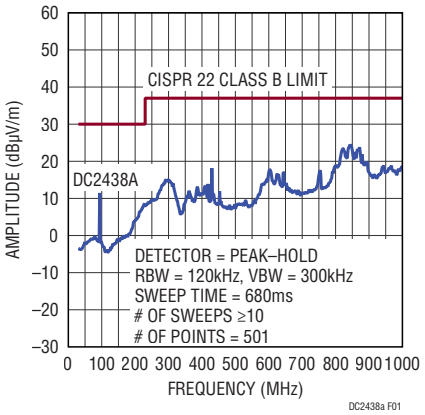


Figure 1. DC2438A Radiated Emissions

QUICK START PROCEDURE

Demonstration circuit 2438A is easy to set up and evaluate the performance of the LTM2894. Refer to Figure 2 for proper measurement equipment setup and follow the procedure below.

NOTE: When measuring the input or output voltage ripple or high speed signals, care must be taken to avoid a long ground lead on the oscilloscope probe.

1. Connect external power supply to V_{CC} and GND if greater than 200mA is required from V_{CC2} or VBUS2.
2. Connect USB cable from computer to input side (J1) of the demo board.
3. Connect computer mouse, low speed device, or USB memory stick, typically high speed device, to output side (J2) of demo board.
4. Verify proper operation of mouse or memory stick.

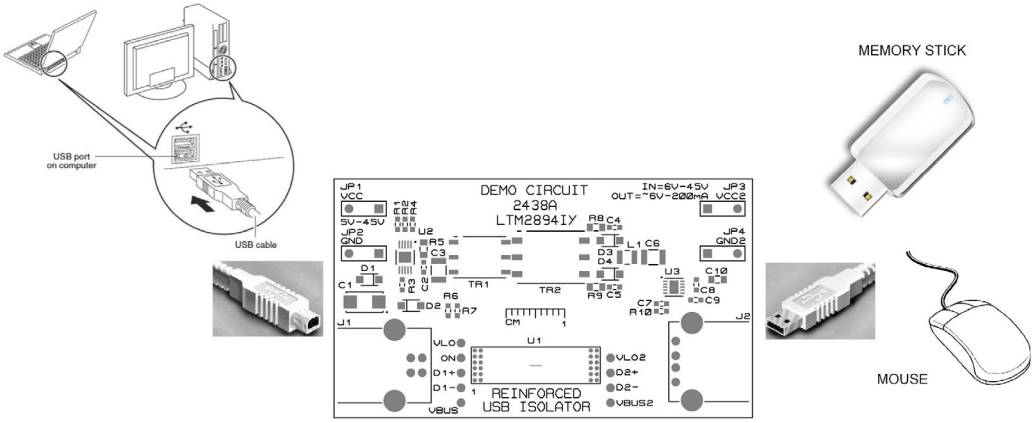


Figure 2. Demo Board Setup

QUICK START PROCEDURE

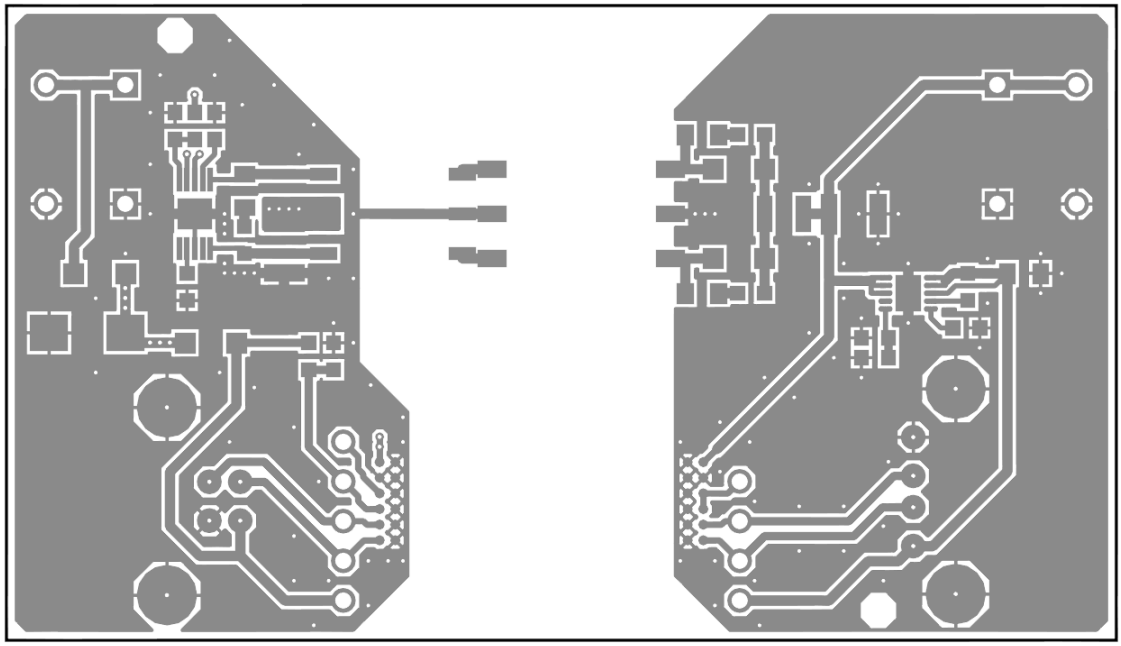


Figure 3. Layer 1 Top Layer

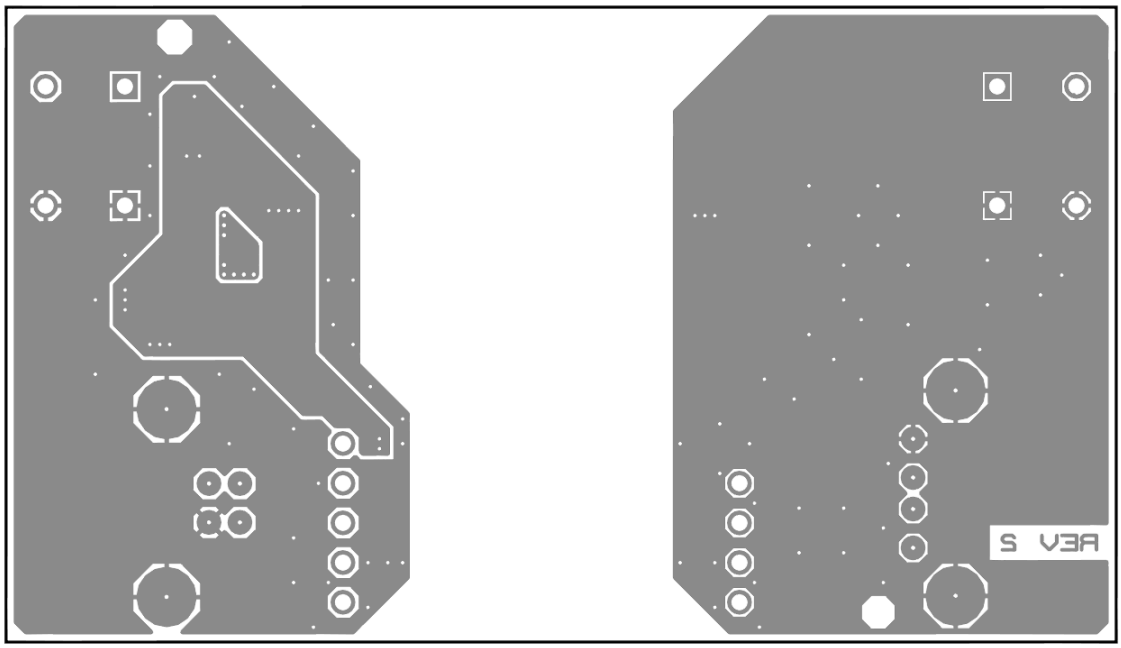
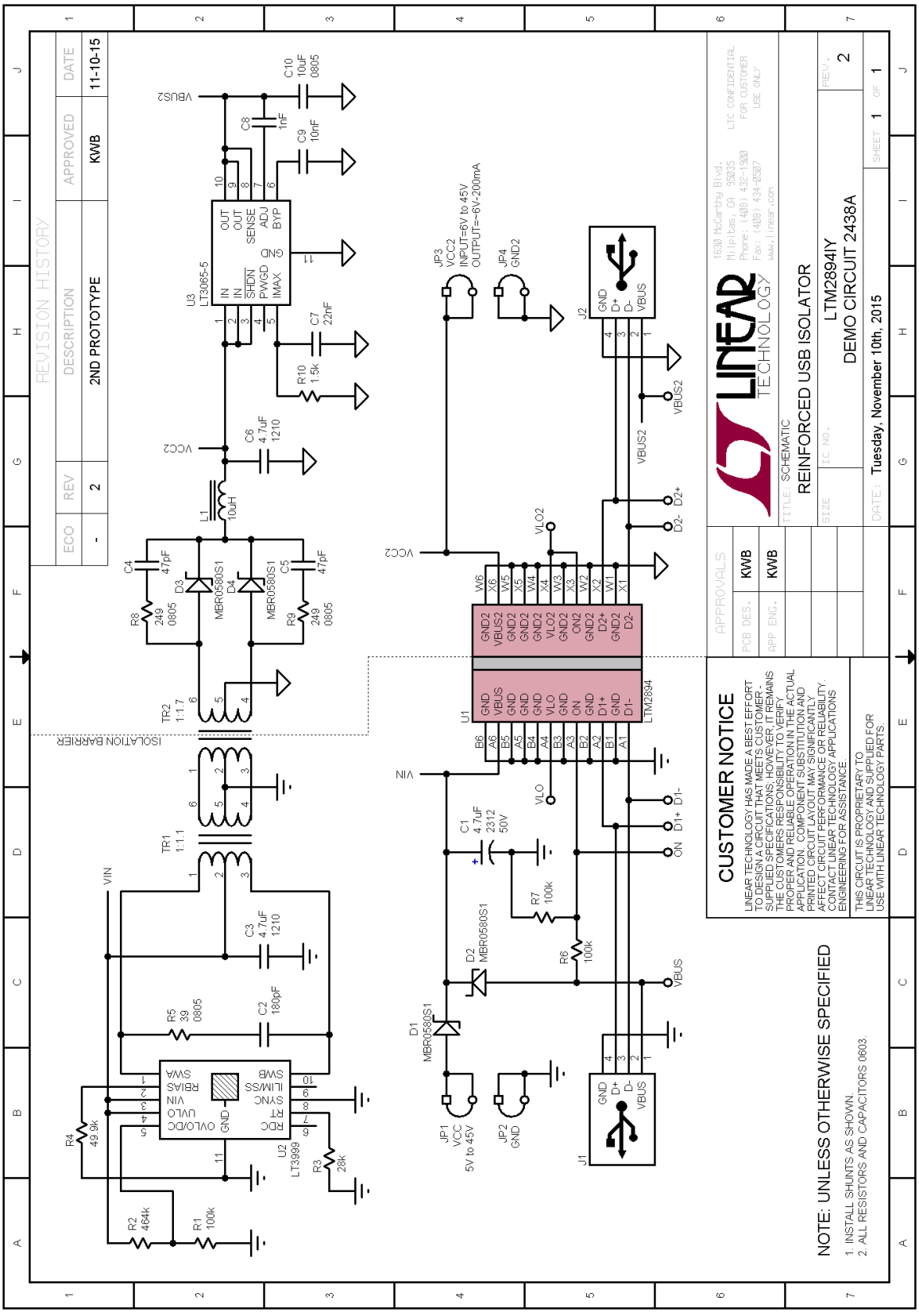


Figure 4. Layer 2 Bottom Layer

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	U1	IC, LTM2894IY	LINEAR LTM2894IY#PBF
Hardware: For Demo Board Only				
2	1	C1	Cap, Tantalum 4.7µF 10% 2312 50V	AVX TAJC475K050RNJ
3	1	C2	Cap, Ceramic 180pF 5% 0603 100V C0G	AVX 06031A181JAT2A
4	2	C3, C6	Cap, Ceramic 4.7µF 10% 1210 50V X7R	AVX 12105C475KAT2A
5	2	C4, C5	Cap, Ceramic 47pF 5% 0603 100V C0G	AVX 06031A470JAT2A
6	1	C7	Cap, Ceramic 22nF 10% 0603 25V X7R	AVX 06033C223KAT2A
7	1	C8	Cap, Ceramic 1nF 10% 0603 50V X7R	AVX 06035C102KAT2A
8	1	C9	Cap, Ceramic 10nF 10% 0603 50V X7R	AVX 06035C103KAT2A
9	1	C10	Cap, Ceramic 10µF 10% 0805 10V X7R	Murata GRM21BR71A106KE51L
10	4	D1 to D4	Diode, Schottky, 80V 500mA SOD123	Diodes Inc. MBR0580S1-7
11	1	J1	USB RECEPTACLE TYPE B	Wurth Elektronik 61400416121
12	1	J2	USB RECEPTACLE TYPE A	Wurth Elektronik 61400416021
13	4	JP1 to JP4	Header, Loop 1x2 0.2˝	Aavid 125700D00000G
14	1	L1	Inducotr, 10µH 1008 0.5Ω 0.25A	Wurth Elektronik 74479888310
15	3	R1, R6, R7	Resistor, 100kΩ 1% 0603	Vishay CRCW0603100KFKEA
16	1	R2	Resistor, 464kΩ 1% 0603	Vishay CRCW0603464KFKEA
17	1	R3	Resistor, 28kΩ 1% 0603	Vishay CRCW060328K0FKEA
18	1	R4	Resistor, 49.9kΩ 1% 0603	Vishay CRCW060349K9FKEA
19	1	R5	Resistor, 39Ω 1% 0805	Vishay CRCW080539R0FKEA
20	2	R8, R9	Resistor, 249Ω 1% 0805	Vishay CRCW0805249RFKEA
21	1	TR1	Transformer, 2.5kV 1:1.1	Wurth Elektronik 760390012
22	1	TR2	Transformer, 5kV 1:1.7	Wurth Elektronik 750313769
23	1	U2	IC, 1A, 1MHz, Push-Pull DC-DC Driver	LINEAR LT3999IMSE#PBF
24	1	U3	IC, 45V V_{IN}, Low Noise, 500mA LDO	LINEAR LT3065IDD-5#PBF

SCHEMATIC DIAGRAM



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LT 0316 • PRINTED IN USA