LTM2884
Isolated USB Transceiver with Isolated Power

DESCRIPTION

Demonstration circuit 1789A is an isolated USB transceiver with isolated power featuring the LTM®2884. The demo circuit features an EMI optimized circuit configuration and printed circuit board layout. All components are integrated into the µModule® isolator. The demo circuit operates from a supply on V_{CC} and/or V_{BUS}. The part generates an isolated output voltage on V_{CC2} and communicates all necessary signaling across the isolation barrier through LTC's isolator µModule technology.

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

PERFORMANCE SUMMARY (T_A = 25°C)

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
V_{CC}	Operating Supply Range (Isolated Power Input)		4.4	12	16.5	V
V_{BUS}	Operating Supply Range (USB Bus Power Input)		4.4	5	16.5	V
V_{CC2}	Regulated Output Voltage	V_{CC} = V_{BUS} = 4.4V, I_{CC2} = 200mA V_{CC} = 8.1V, I_{CC2} = 500mA	4.75 4.75	5 5	5.25 5.25	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	560 400			V_{DC} V_{RMS}
	Common Mode Transient Immunity		30			kV/µs

OPERATING PRINCIPLES

The LTM2884 contains an isolated DC/DC converter delivering power to V_{CC2} at 5V 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 LTM2884. The logic side ON pin enables or shuts down the LTM2884. All logic side signals are referenced to the logic supply pin V_{LO}. The LTM2884 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 8.1V to 16.5V. V_{BUS} may be connected to USB bus power or to the external supply. For applications requiring 200mA or less connect V_{CC} and V_{BUS} to USB bus power.

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 and low speed devices the pull-up is asserted on $D1^+$ and $D1^-$, respectively. The downstream USB data pins, $D2^+$ and $D2^-$, each have integrated 15k pull-down resistors.

OPERATING PRINCIPLES

The LTM2884 includes a suspend power feature that when enabled (high) reduces the supply current on V_{CC} and V_{BUS} when the upstream USB bus is idle. However, in this mode, if a downstream device is connected or disconnected from the bus or remote wake-up functionality is configured, it will not be recognized by the LTM2884 and relayed to the host. A resume command at the upstream side will wake up the LTM2884 and a re-numeration by the host will be required. If suspend power is configured low the LTM2884 operates in a low power mode but will respond to disconnects, reconnects, downstream wake-up commands, or host resume commands.

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.

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."

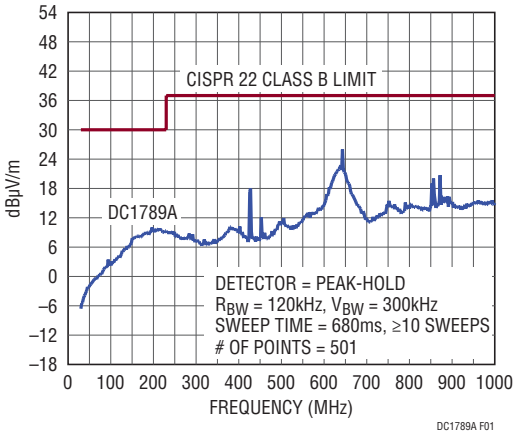


Figure 1. DC1789A Radiated Emissions, Normalized to 10m per IEC 61000-4-20

QUICK START PROCEDURE

Demonstration circuit 1789A makes it easy to set up and evaluate the performance of the LTM2884. 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. Place jumpers in their default positions:

   JP1 V_{CC} supply in the V_{BUS} position

   JP2 V_{BUS} supply in the V_{BUS} position

   JP3 SUSPEND POWER in the OFF position

   JP4 C2 in the OUT position

   NOTE: To simulate a hub/splitter output, C2 can be jumpered IN. The additional capacitance reduces V_{BUS} droop on downstream device plug-in.

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.

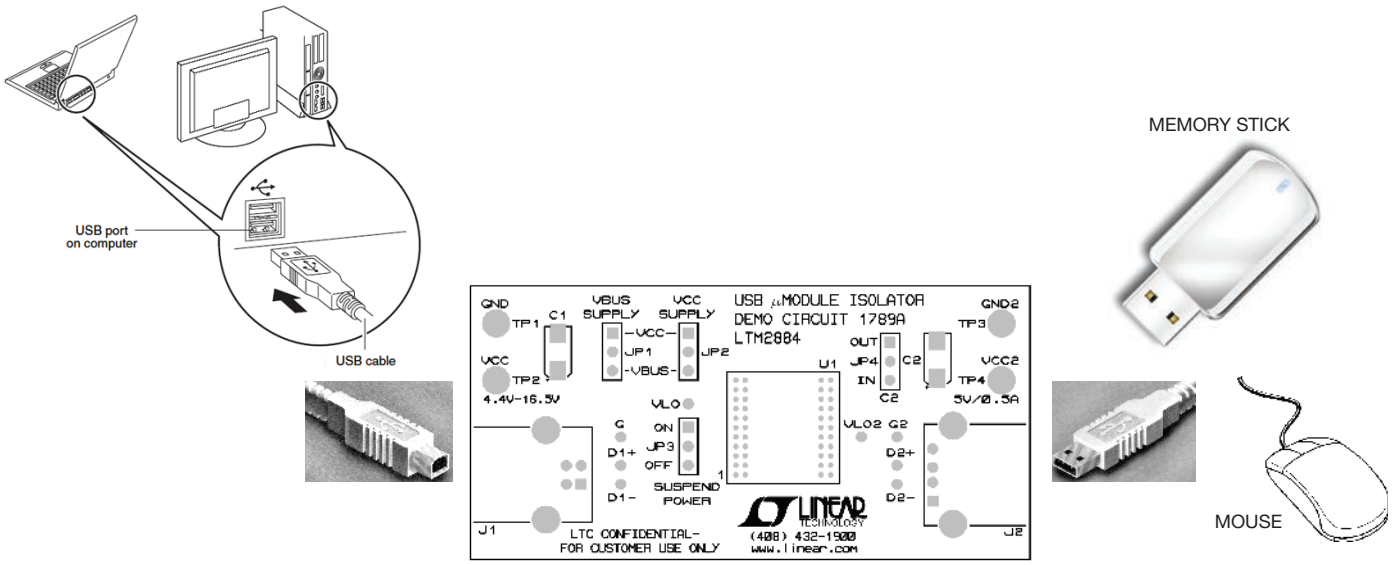
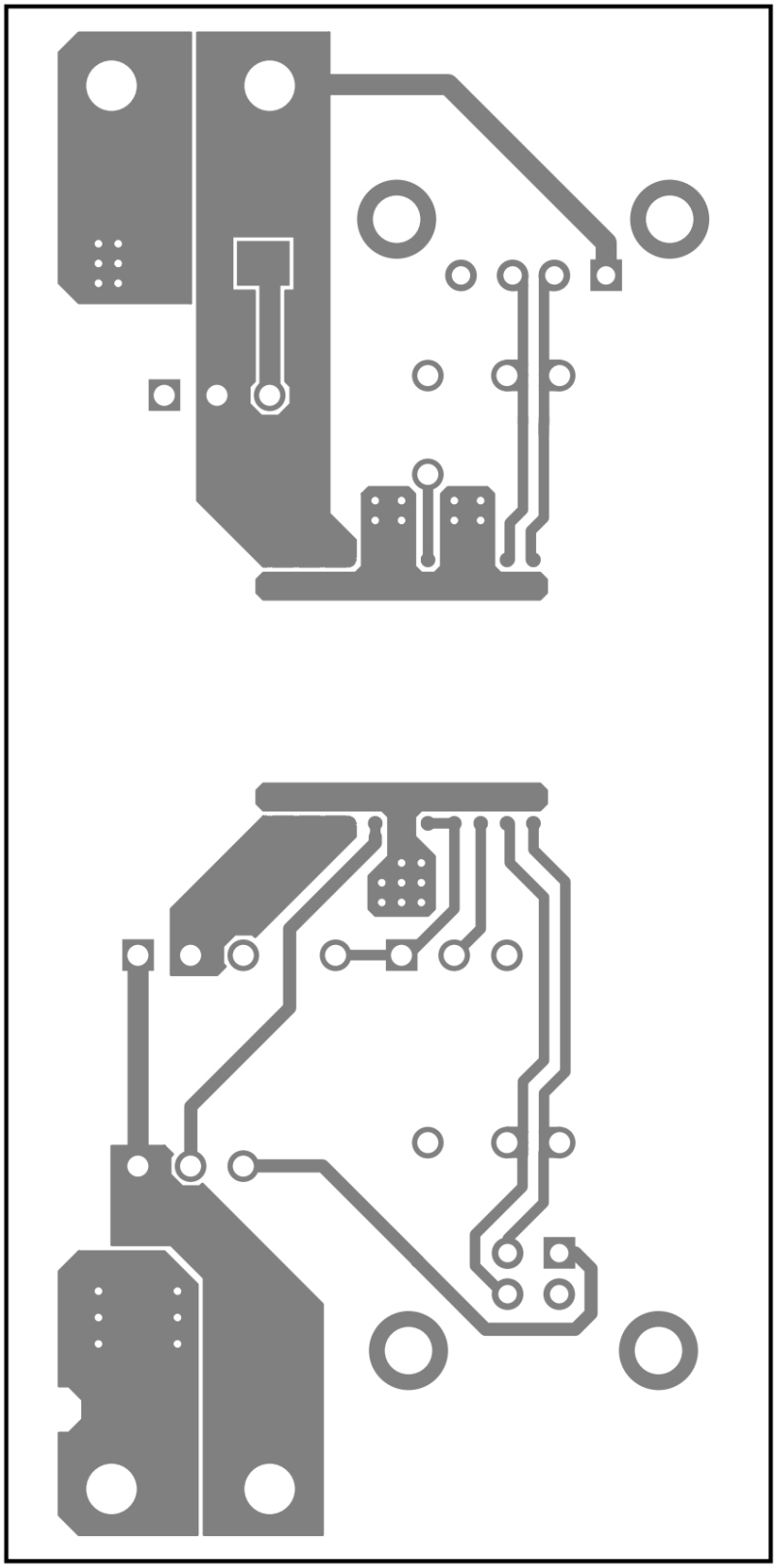


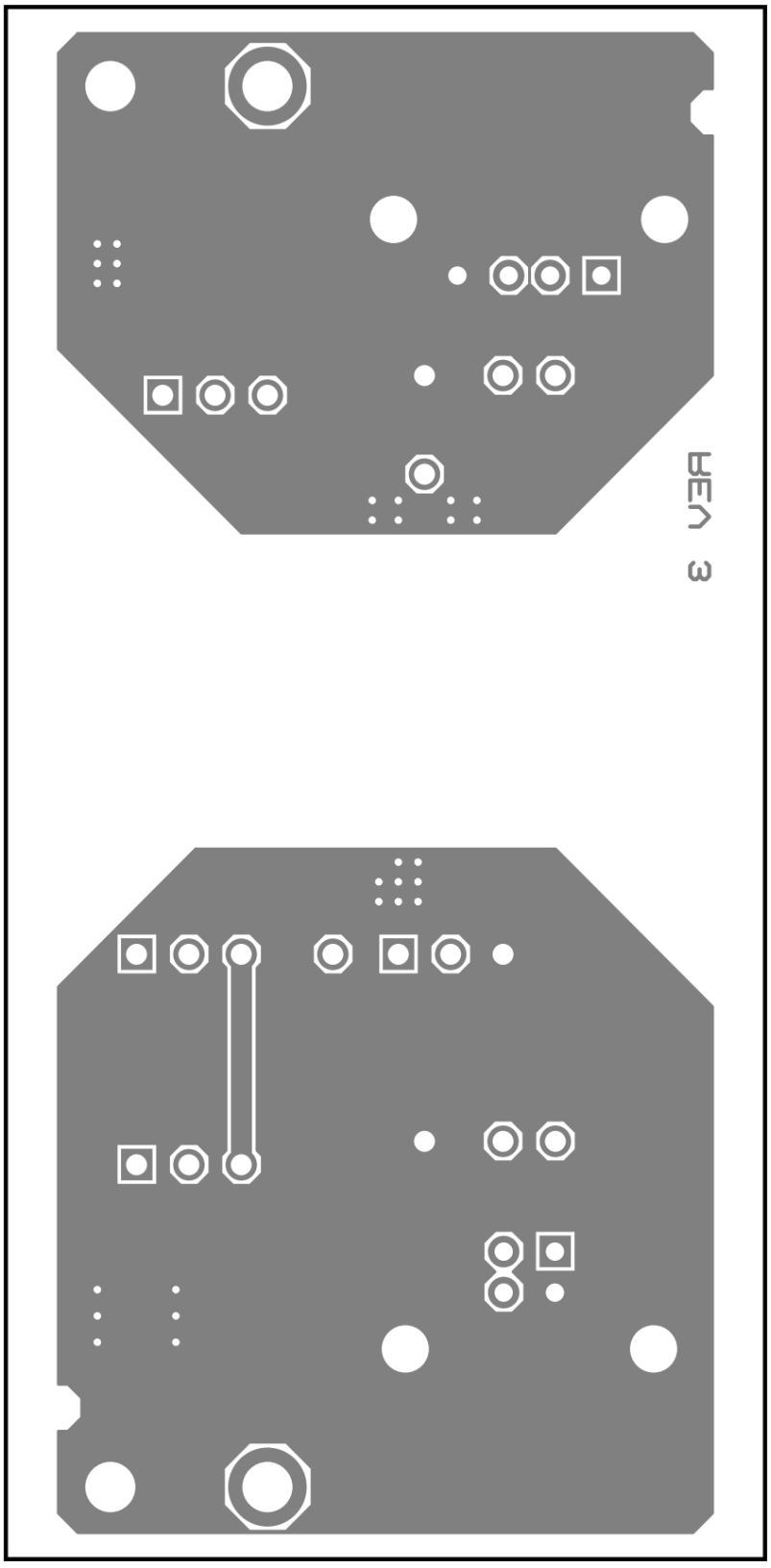
Figure 2. Demo Board Setup

PCB LAYOUT



Layer 1. Top Layer

PCB LAYOUT

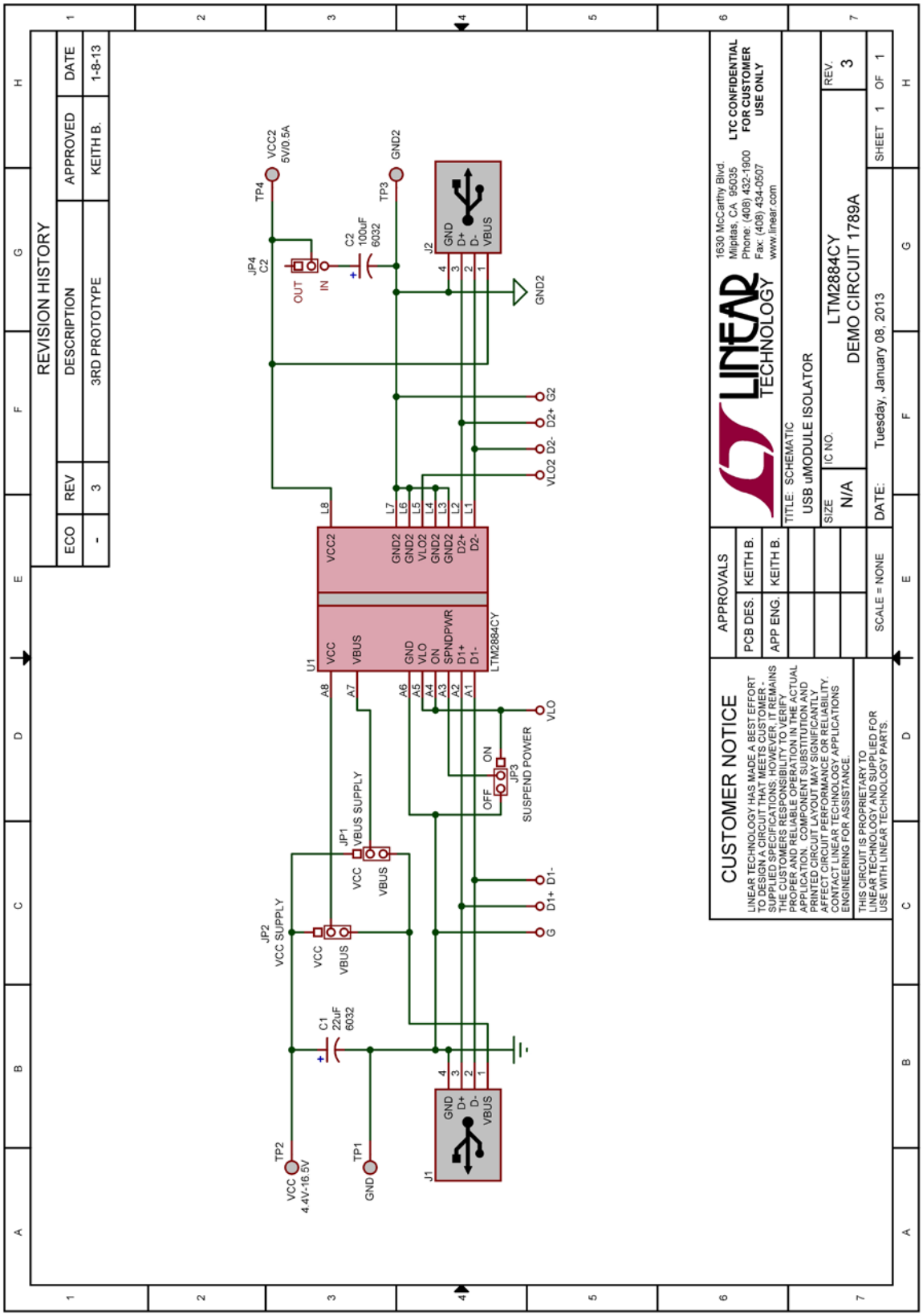


Layer 2. Bottom Layer

PARTS LIST

ITEM	QTY	REFERENCE	PART DESCRIPTION	MANUFACTURER/PART NUMBER
Required Circuit Components				
1	1	U1	I.C., LTM2884CY	LINEAR LTM2884CY#PBF
Hardware/Components (For Demo Board Only)				
2	1	C1	CAP., TANT 22F 25V 20% 'C'	AVX TAJC226M025R
3	1	C2	CAP., TANT 100F 10V 20% 'C'	AVX TPSC107M010R0150
4	1	J1	USB RECEPTACLE TYPE B	MILL-MAX 897-43-004-90-00000
5	1	J2	USB RECEPTACLE TYPE A	MILL-MAX 896-43-004-90-00000
6	3	JP1-4	0.1" SINGLE ROW HEADER, 3-PIN	SAMTEC TSW-103-26-L-S
7	3	JP1-4	SHUNT	SAMTEC SNT-100-BK-G
8	4	TP1-4	TESTPOINT, TURRET, 0.095	MILL-MAX 2501-2-00-80-00-00-07-0

SCHEMATIC DIAGRAM



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Mailing Address:

Linear Technology
1630 McCarthy Blvd.
Milpitas, CA 95035

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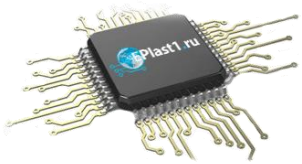

Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.