DALLAS SEMICONDUCTOR

DS4201 REFERENCE DESIGN: USB BUS POWERED SPEAKER

USB POWER OVERVIEW

The USB specification defines two device power configurations: self powered and bus powered. Self powered devices draw most of their power from an external source and may draw up to 100mA from the bus. Bus powered devices draw all their power from USB. For bus powered devices, the USB specification defines two type of devices: high power and low power. Low power functions are those that draw less than 100mA from the bus. High power functions are those that draw more than 100mA but are limited to 500mA. With the MaxPower configuration descriptor, a USB device reports whether it is a low or high powered function.

For USB hubs there are two classifications: bus-powered and self-powered. Bus-powered hubs get all power from USB. Each down stream port from a bus-powered hub can provide **NO MORE** than 100mA. Self-powered hubs have a local power supply. Each down stream port from a self-powered hub can provide up to 500mA.

In addition to operating current consumption, the USB specification imposes two additional power requirements on devices: in-rush current draw at device attachment and suspend state current consumption. In-rush current is not explicitly defined as an amperage value in the USB specification. Instead the worst case load a USB peripheral should present to the bus upon attachment is specified as 10µF in parallel with 44Ω. The 44Ω resistive value equates to 100mA at the minimum allowable bus voltage of 4.4V. The intent of the USB specification is to limit the amount of voltage droop due to in-rush current to 330mV. This is accomplished with the load of 44Ω paralleled with 10µF. For measurement/evaluation purposes, a good rule of thumb is to limit in-rush current to 500mA maximum. Finally, all devices which draw power from the bus must be able enter the suspend state and reduce their current consumption from the bus to less than 500 µA.

USB BUS POWERED SPEAKERS

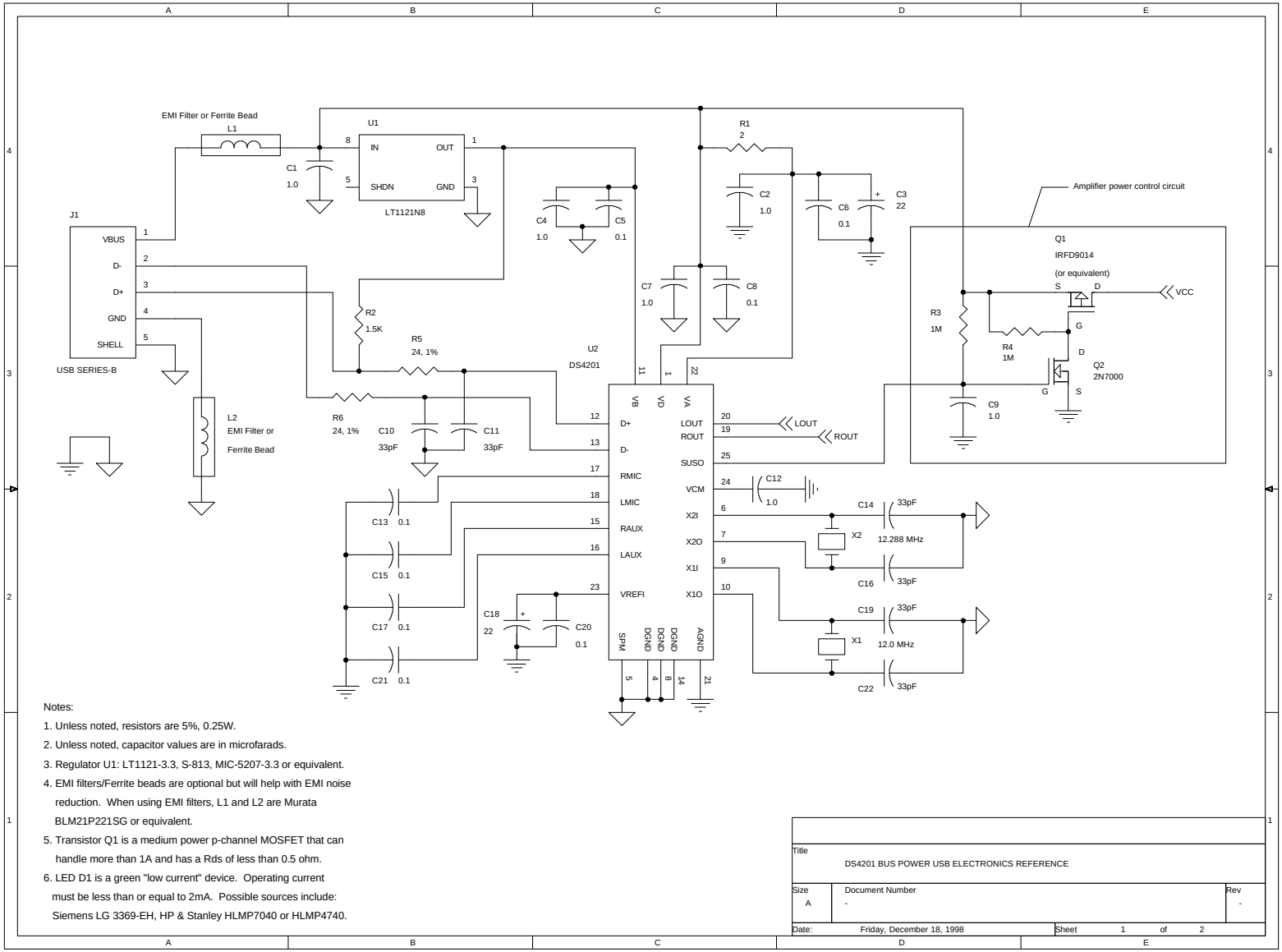
With a nominal bus power voltage of 5V and 500mA of available current, it is possible to build a set of bus powered USB speakers that have a total power budget of approximately 2.5W. The schematic that accompanies this document provides a reference design that has been implemented and tested by Dallas Semiconductor.

One of the challenges to implement a bus powered speaker set is satisfying USB in-rush and suspend current requirements. The DS4201 $\overline{\text{SUSO}}$ output signal combined with minimal external circuitry, can be used to implement a power control circuit to satisfy both requirements; the power control circuit is highlighted on sheet one of the reference schematic. The $\overline{\text{SUSO}}$ output signal is used to turn the power control circuit on/off. The power control circuit is turned off when USB enters a suspend state or before the DS4201 is configured. When the DS4201 is configured and USB is in an active state the power control circuit is turned on. Upon initial attachment to the bus, the power control circuit is off thus disconnecting the amplifier and large filter capacitance from the bus, this prevents large in-rush currents from being generated. When USB goes into a suspend state the power control circuit is again off and the DS4201 goes into a low power mode enabling the 500 µA requirement to be satisfied.

This unique combination of a DS4201 specific control signal, $\overline{\text{SUSO}}$, and simple/inexpensive external circuitry enables a USB compliant bus powered speaker solution to be designed for high volume production.

USB SPECIFICATION CONSIDERATIONS

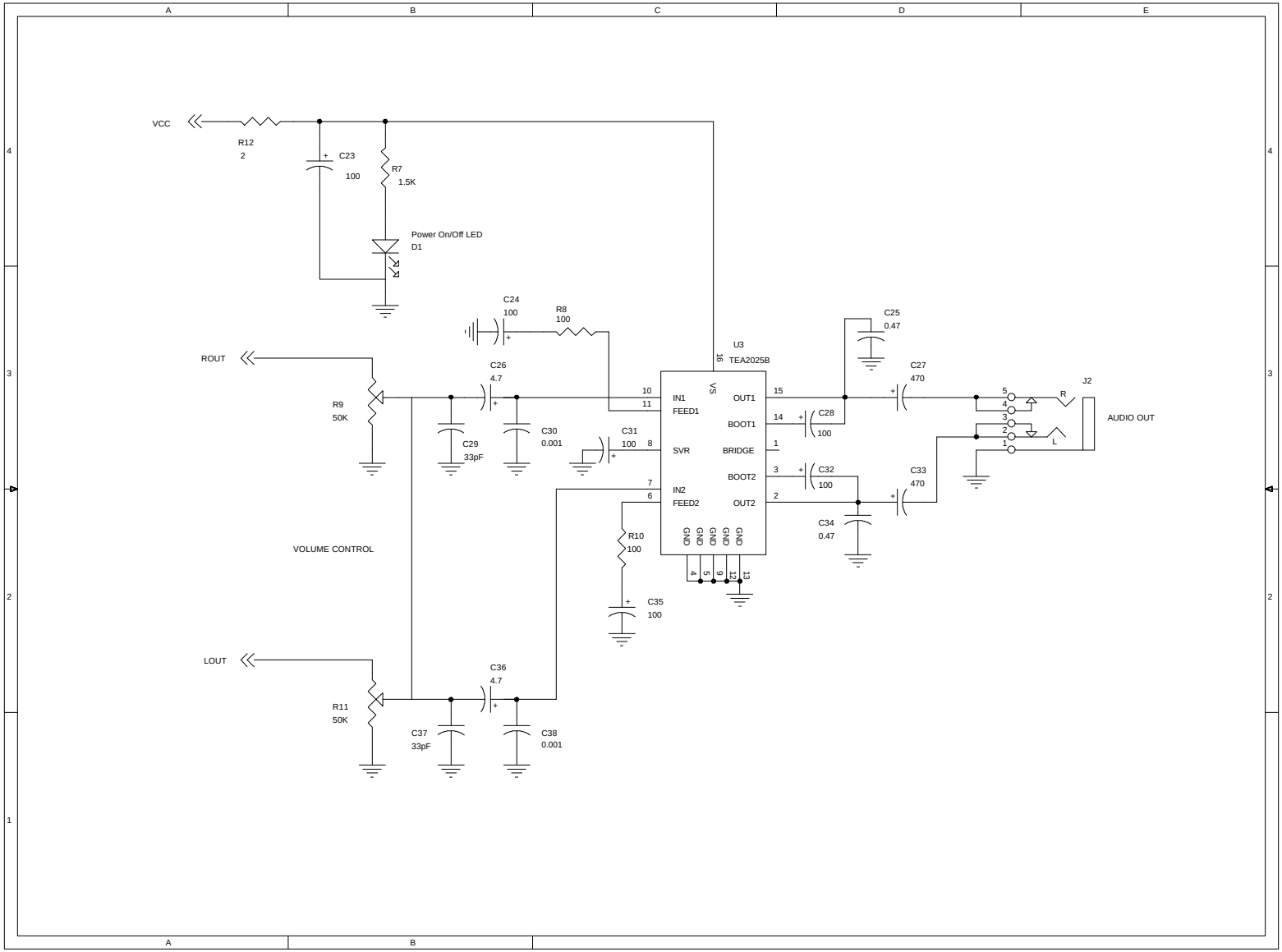
Devices that draw more than 100mA from the bus are high powered devices and must be reported as so with the MaxPower configuration descriptor. Bus powered hubs can provide no more than 100mA to an attached device, therefore high powered devices cannot be used with bus powered hubs. Dallas Semiconductor assumes no responsibility with bus powered speaker designs and system configurations that violate these two specification requirements.



Notes:

1. Unless noted, resistors are 5%, 0.25W.
2. Unless noted, capacitor values are in microfarads.
3. Regulator U1: LT1121-3.3, S-813, MIC-5207-3.3 or equivalent.
4. EMI filters/Ferrite beads are optional but will help with EMI noise reduction. When using EMI filters, L1 and L2 are Murata BLM21P221SG or equivalent.
5. Transistor Q1 is a medium power p-channel MOSFET that can handle more than 1A and has a Rds of less than 0.5 ohm.
6. LED D1 is a green "low current" device. Operating current must be less than or equal to 2mA. Possible sources include: Siemens LG 3369-EH, HP & Stanley HLMP7040 or HLMP4740.

Title: DS4201 BUS POWER USB ELECTRONICS REFERENCE		
Size: A	Document Number: -	Rev: -
Date: Friday, December 18, 1998	Sheet 1 of 2	


A
B
C
D
E
VCC
R12
2
C23
100
R7
1.5K
Power On/Off LED
D1
C24
100
R8
100
C25
0.47
U3
TEA2025B
16
ROUT
C26
4.7
C27
470
J2
R9
50K
10
11
IN1
FEED1
VS
OUT1
15
5
4
3
2
1
R
L
AUDIO OUT
C29
33pF
C30
0.001
C31
100
8
SVR
BOOT1
14
C28
100
BRIDGE
1
BOOT2
3
C32
100
C33
470
7
6
IN2
FEED2
OUT2
2
C34
0.47
VOLUME CONTROL
R10
100
GND
GND
GND
GND
GND
4
5
9
12
13
C35
100
LOUT
C36
4.7
R11
50K
C37
33pF
C38
0.001