EVALUATION BOARD FOR THE Si2400 WITH A UART INTERFACE

Description

The Si2400URT-EVB evaluation board provides the system designer an easy way to evaluate the Si2400 ISOmodem®. The Si2400URT-EVB consists of a motherboard and power supply, an RS-232 interface and USB, other ease-of-use features, and a complete, removable modem module on a daughter card. (A functional block diagram of the Si2400URT-EVB is shown below.) The Si2400 ISOmodem is a complete controller-based modem chipset with an integrated and programmable direct access arrangement (DAA) that meets global telephone line requirements. Available as two 16-pin small outline (SOIC) packages, the Si2400 ISOmodem eliminates the need for a separate DSP data pump, modem controller, memories, analog front end (AFE), isolation transformer, relays, opto-isolators, and a 2- to 4-wire hybrid. The Si2400 is ideal for embedded modem applications due to its small board area, controller-based architecture, low power consumption, and global compliance. The Si2400URT-EVB provides an RJ-11 jack and a DB9 connector for interfacing the Si2400URT-EVB to the phone line and a PC or data terminal serial port. This allows the Si2400 ISOmodem to operate as a serial modem for straightforward evaluation. To evaluate the Si2400 ISOmodem in an embedded system, the daughter card can be used independently or with the motherboard. A direct access header (JP3) is available on the motherboard to bypass the RS-232 transceivers and connect the Si2400 ISOmodem directly to a target system. The EVB also provides test points for access to the analog input and analog output. These interfaces can be used to evaluate the Si2400 PCM and voice modes. Given that any of the GPIO pins may be used as an audio input, the EVB provides access to all GPIO pins.

Power is supplied through a screw terminal (J3) or a standard 2 mm power jack (J4). An onboard rectifier, filter, and voltage regulator allow the power input to be 7.5–13 V ac or dc (either polarity). Alternatively, power can be supplied through the USB interface (whether or not the USB interface is used). The Si2400URT-EVB can drive an external speaker for call monitoring, or a piezoelectric speaker can be mounted directly on the board in the space provided.

Features

The Si2400URT-EVB includes the following:

- Dual RJ-11 connection to phone line
- RS232 and USB interface to PC
- Audio connector for call monitoring
- Direct access to Si2400 for embedded application evaluation
- Easy power connection to common 7.5–13.5 V power supplies
- 9 V ac adaptor
- Simple installation and operation

Functional Block Diagram
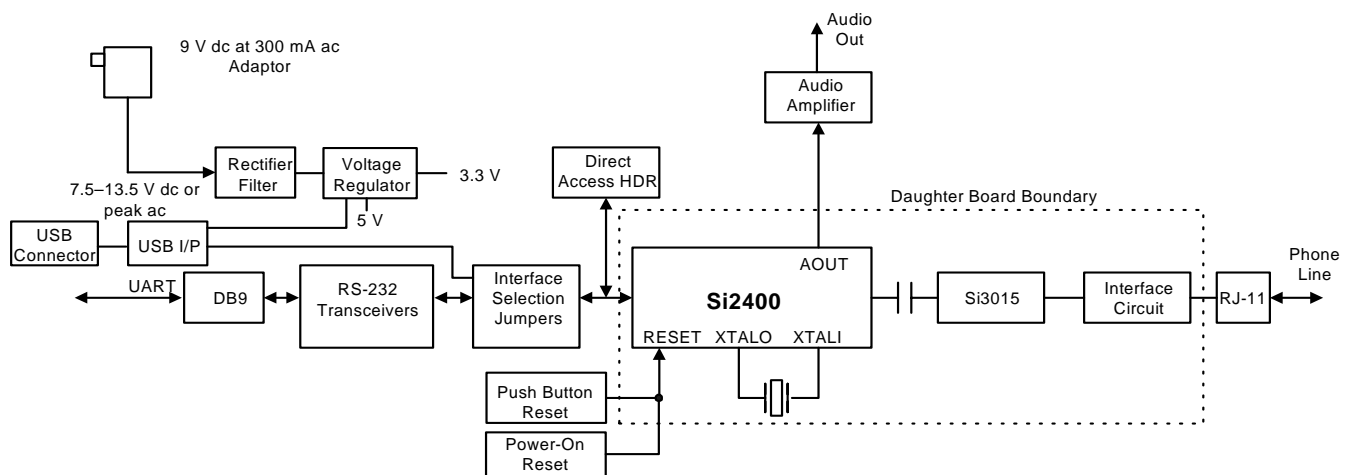
Si2400URT-EVB

1. Introduction

Notable differences between the Si2400 and other ISOmodem products are highlighted in the bulleted list below. For complete details and specifications, please refer to the current Si2400 data sheet.

Unique Si2400 Features:

- Many AT commands execute when entered without <CR>.
- AT commands must be entered in uppercase.
- The +++ escape sequence is disabled at power-up and/or reset.
  - ATS14=20 enables +++ escape.
- S-Register address and value are entered in hex (example: ATS0F=2B)
- Result codes are abbreviated (example: "O" instead of "OK").
- The Si2400DC power can be 3.3 V or 5 V (3.3 V used on motherboard).
- Several AT commands are required to enable the speaker.
  - ATSF4=00 removes Tx and Rx audio mute.
  - ATSE4=02 turns on ADC and DAC power.
  - ATM2 turns on speaker continuously.
- DTE interface default is 8N1, 2400 bps, no handshaking, and no linefeeds with carriage returns.
- ATDT is disabled if linefeeds with carriage returns are enabled.
- Some common AT Commands are not available:
  - ATH1
  - A/
  - ATD (must be ATDT or ATDP)
  - AT&Tn (use ATSE4=20 for local digital loopback)

Table 1. Modem Configuration Examples

Modulation	ATS07 =
V22bis	06
V.22	02
V.21	03
Bell 212A	00
Bell 103	01
V.23 (1200 TX, 75 RX—Answer)	14
V.23 (75 TX, 1200 RX—Originate)	24
V.23 (600 TX, 75 RX—Answer)	10
V.23 (75 TX, 600 RX—Originate)	20

Table 2. Modem Initialization Example

Command	Function
ATS00=02	Auto-answer after two rings
ATS07=06	Configures modem for V.22b
ATS14=20	Enables +++ escape
ATSF4=00	Removes audio mute
ATSE4=02	Turns on audio ADC and DAC
ATM1	Turns on speaker until carrier negotiated

2. Si2400URT-EVB Setup and Evaluation

This section explains how to set up the Si2400URT-EVB for evaluation as an RS-232 or USB interface modem. Jumper settings, power connection, PC/terminal connections, and terminal program configuration settings are given. After power is applied, initial modem setup instructions and a basic tutorial on modem operation are provided. Si2400URT-EVB configurations for evaluating additional features are discussed separately.

2.1. Si2400URT-EVB Quick Start—RS-232 Interface

1. Set jumpers according to Figure 1.
2. Connect:
   - DB-9 to PC COM 1 (with a pass-through cable).
   - RJ-11 to phone line or test box.
   - the 9 V ac adaptor (or USB cable).
3. Bring up:
   - Turn on power to modem.
   - Set Terminal Program for 2400 bps 8N1. Hardware flow control. Disable linefeeds with carriage returns (linefeeds with carriage returns disable ATDT commands).
4. Type "AT" followed by a carriage return.
   - Should echo "AT" and then an "O".
5. Type:
   - ATS14 = 20 to enable +++ escape.
   - ATS07 = 06 to enable V.22b.
   - ATS00 = 01 for auto-answer on first ring.

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2.2. Si2400URT-EVB Quick Start—USB Interface

1. Set jumpers according to Figure 2.
2. Connect:
   - USB cable to PC.
   - RJ-11 to phone line or test box.
3. Download USB driver for your operating system from the CD supplied with the evaluation board.
4. Install driver.
5. Bring up:
   - Reset the modem.
   - Set Terminal Program for 2400 bps 8N1. Hardware flow control. Disable linefeeds with carriage returns (linefeeds with carriage returns disable ATDT commands).

6. Type "AT" followed by a carriage return.
   - Should echo "AT" and then an "O".
7. Type:
   - ATS14=20 to enable +++ escape.
   - ATS07=06 to enable V.22b.
   - ATS00=01 for auto-answer on first ring.

2.3. Jumper Settings

Check all jumper settings on the Si2400URT-EVB before applying power. Figure 1 shows the standard factory jumper settings. These settings configure the Si2400URT-EVB for RS-232 serial operation. Any standard terminal program configured to communicate through a PC COM port can be used to communicate with the Si2400URT-EVB. To connect the modem directly into an embedded system with LVCMOS/TTL levels, install JP8 to disable both the RS-232 and USB interfaces. Connection to the embedded system can be made to JP-3. Place a jumper on JP13 to enable the onboard speaker, LS1.
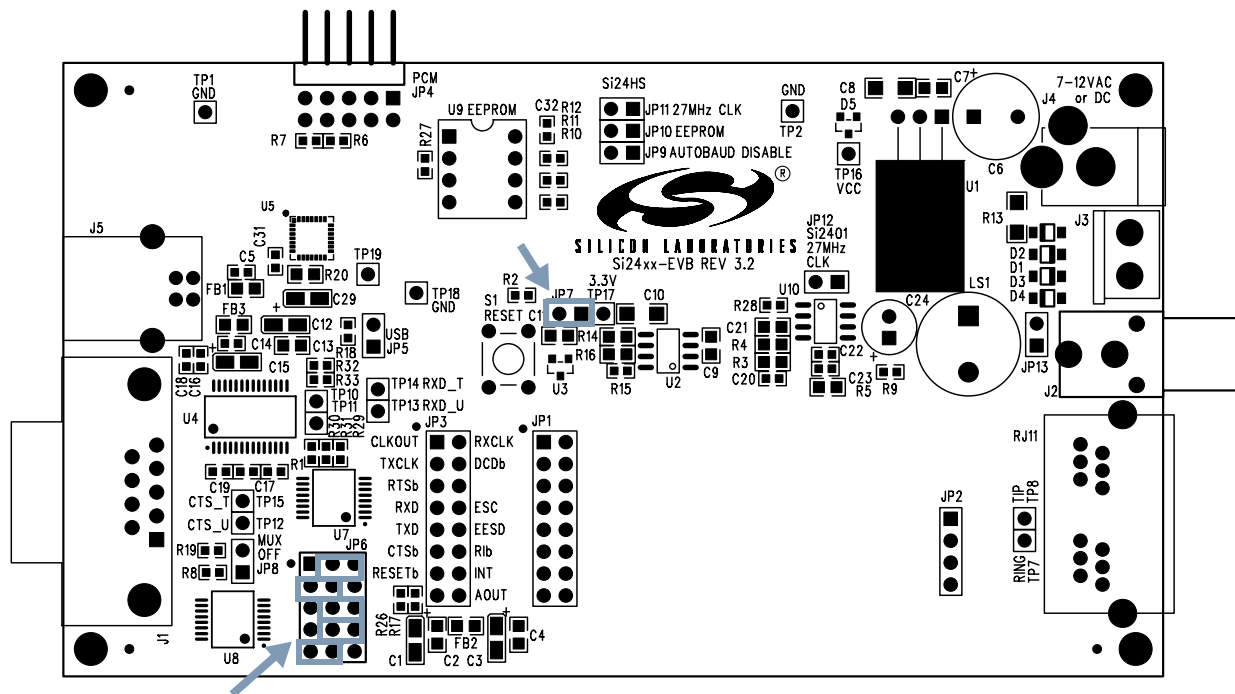

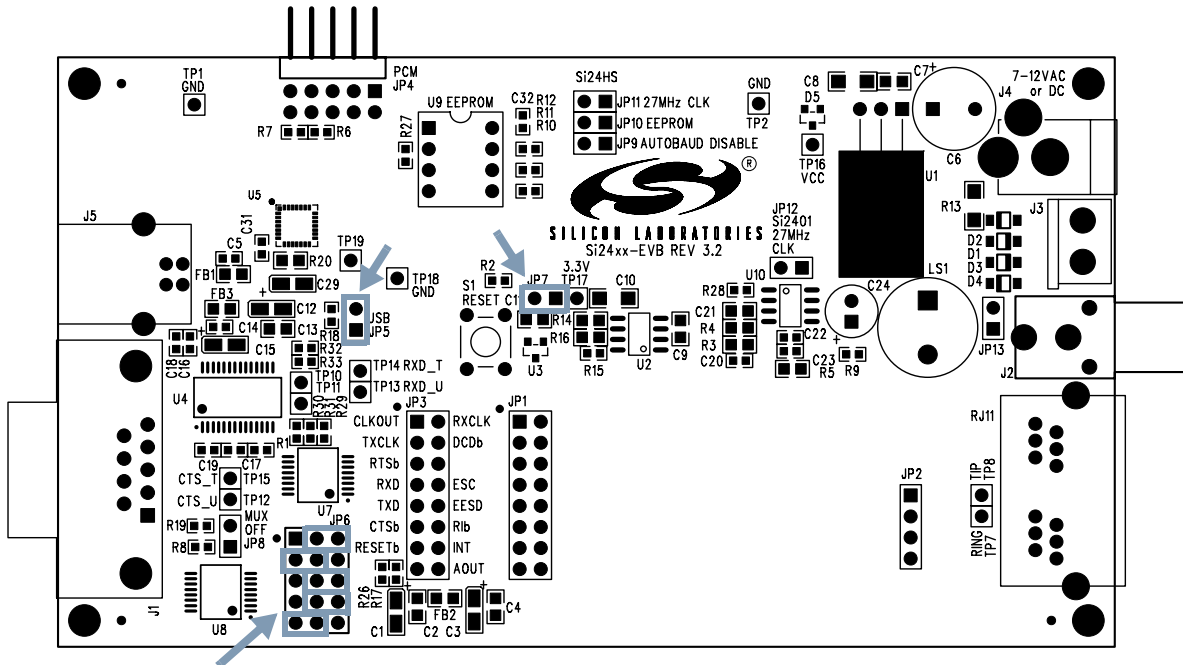**Figure 1. Jumper Settings—RS-232 Interface (Outlined in Gray)**

Figure 2. Jumper Settings—USB Interface (Outlined in Gray)

2.4. Power Requirements

The Si2400URT-EVB has an onboard diode bridge, filter capacitor, and voltage regulator. Power can be supplied from any source capable of providing 7.5–13 V dc or 7.5–13 V peak ac and at least 100 mA. (Additional current may be required if a speaker is connected for monitoring call progress tones.) Power may be applied to the Si2400URT-EVB through the screw terminals (J3) or the 2 mm power jack (J4). The onboard full-wave rectifier and filter ensure that the correct polarity is applied to the Si2400URT-EVB. Daughter card power is supplied through voltage regulator U2 and is factory set at 3.3 V. Power is also supplied by the USB cable and can be used regardless of whether the modem is configured for USB, RS-232, or direct interface mode. Daughter card current can be measured by connecting an ammeter between JP7 pins 1 and 2. These pins must always be connected. Failure to connect pins 1 and 2 of JP7 through either a jumper or a low-impedance ammeter may result in damage to the Si2400URT-EVB.

2.5. Terminal and Line Connections

The Si2400 can be tested as a standard serial data modem by connecting the Si2400URT-EVB to a personal computer or other data terminal equipment (DTE), phone line, and power. Connect a PC, RS-232, or USB interface to the Si2400URT-EVB with the appropriate cable. The RS-232 transceivers on the EVB can communicate with the DTE at rates of up to 1 Mbps.

Any standard terminal program, such as HyperTerminal or ProComm, running on a PC can communicate with the Si2400URT-EVB. Configure the terminal emulation program to 2400 bps, 8 data bits, no parity, one stop bit, and hardware flow control. Also, be sure to disable linefeeds with carriage returns. Connect the RJ-11 jack on the Si2400URT-EVB to an analog phone line or telephone line simulator, such as a Teltone TLS 5.

2.6. Making Connections

With the terminal program properly configured and running, apply power to the Si2400URT-EVB. Type "AT<CR>", and the modem should return "O", indicating the modem is working in the command mode and communicating with the terminal. If the "O" response is not received, try resetting the modem by pressing the manual reset switch (S1); then type "AT<CR>" again. Ensure that sure all commands are entered using uppercase letters.

To take the modem off-hook, type "ATDT<CR>." The modem should go to the off-hook state, draw loop current, and respond with a "t", indicating a dial tone detection. Typing any characters makes the modem hang up (go on-hook) and stop drawing loop current.

To make a modem connection, type "ATDT(called modem phone number)<CR>." Once the connection is established, a "c" message appears indicating the two modems are in the data mode and communicating. Typing on one terminal should appear on the other terminal. To return to the command mode without

interrupting the connection between the two modems, type "+++." Approximately two seconds later, "O" will appear. The modem is now in command mode and will accept "AT" commands. To return to the data mode, type "ATO." The modem resumes the data connection and no longer accepts AT commands. Type "ATH" to terminate the data connection.

3. Si2400URT-EVB Functional Description

The Si2400URT-EVB is a multipurpose evaluation system. The modem daughter card illustrates the small size and small number of components required to implement an entire controller-based modem with global telecommunications compatibility. The daughter card can be used independently of, or in conjunction with, the motherboard. The motherboard adds features that enhance the ease of evaluating the many capabilities of the Si2400 ISOmodem®.

3.1. Motherboard

The motherboard provides a convenient interface to the Si2400DC (daughter card). The versatile power supply allows for a wide range of ac and dc voltages to power the board. RS-232 transceivers and a DB9 connector allow the Si2400URT-EVB to be easily connected to a PC or other terminal device. Jumper options allow direct access to the LVCMOS/TTL level serial inputs to the Si2400, bypassing the RS-232 transceivers or USB interface. This is particularly useful for directly connecting the Si2400 to embedded systems.

The Si2400URT-EVB motherboard connects to the daughter card through two connectors, JP1 and JP2. JP1 is an 8x2 socket providing connection to all Si2400 digital signals and regulated 3.3 V power for the Si2400. The Si2400 digital signals appearing at JP1 (daughter card interface) are LVCMOS and TTL compatible. The Si2400DC must be powered by 3.3 V. The motherboard is factory-configured for 3.3 V with JP7 pins 1 and 2. JP2 is a 4x1 socket providing connection between the daughter card and the RJ-11 phone jack.

3.1.1. Voltage Regulator/Power Supply

The input voltage to either J3 or J4 must be between 7.5 and 13.5 V dc or 7.5 and 13.5 V_{PEAK} ac. The motherboard includes a diode bridge (D1–D4) to guard against a polarity reversal of the dc voltage or to rectify an ac voltage. The power source must be capable of continuously supplying at least 100 mA. C50 serves as a filter cap for an ac input. The voltage regulator, U1, provides 5 V for the motherboard and the input for voltage regulator U2, which outputs 3.3 V for use on the motherboard and to power the daughter card. Si24xxDC power consumption can be measured by placing a meter between pins 1 and 2 of JP7. The connection between JP7 pins 1 and 2 must be made at all times when power is applied to the evaluation board either through a jumper block or a low-impedance meter to avoid damage to the daughter card. Power is supplied to U2 through D5 from the USB.

3.1.2. Reset Circuitry

The Si2400 requires a reset pulse to remain low for at least 5.0 ms after the power supply has stabilized during the powerup sequence or for at least 5.0 ms during a power-on reset, then go high with a rise time <100 ns. Most production Si2400 modem chipset applications require that RESET be controlled by the host processor. Certain Si2400 operation modes, including Powerdown, require a hardware reset to recover.

The Si2400URT-EVB contains two reset options, an automatic power-on reset device, U3 (DS1818) (default), and a manual reset switch (S1) to permit resetting the chip without removing power. A reset, regardless of the mechanism, causes all modem settings to revert to factory default values. See Figure 6 on page 12 and Figure 8 on page 14 for the reset circuit schematic.

3.1.3. DS1818

The DS1818 is a small, low-cost device that monitors the voltage on V_D and an external reset pushbutton. If V_D drops below 3.0 V, the DS1818 provides a 220 ms active-low reset pulse. Upon powerup, the DS1818 also outputs an active low reset pulse for 220 ms after V_D reaches 90% of the nominal 3.3 V value. The DS1818 outputs a 220 ms reset pulse any time the power supply voltage exceeds the 3.3 V ±10% window.

3.1.4. Manual Reset

The manual reset switch, S1, performs a power-on reset. This resets the Si2400 to factory defaults without turning off power. If S1 is used in conjunction with U6, pressing S1 activates the reset monitor in the DS1818 and produces a 220 ms active low reset pulse.

3.1.5. Interface Selection

The serial interface of the Si2400USB-EVB can be connected to a computer terminal, embedded system, or any other Data Terminal Equipment (DTE) via a standard RS-232 interface, USB interface, or through a direct TTL serial interface.

The Si2400 can be tested as a standard data modem by connecting the Si2400USB-EVB to a personal computer or other DTE, power supply, and a phone line. A PC can communicate with the Si2400USB-EVB using a standard terminal program, such as HyperTerm or ProComm.

Jumper settings determine how the Si2400USB-EVB is

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connected to the DTE. Table 3 lists the interface controlled by each motherboard jumper. See Figure 7 on page 13 and Figure 17 on page 23.

Table 3. Interface Selection Jumpers

Jumper	Function
JP1	Daughter Card Phone Line Connector.
JP2	Daughter Card Digital Connector.
JP3	Direct Access Header.
JP4	Not Used.
JP5	USB Enable (RS-232 Disable).
JP6	Options.
JP7	3.3 V Power for Daughter Card.
JP8	Disable both RS-232 and USB.
JP9	Not Used.
JP10	Not Used.
JP11	Not Used.
JP12	Enable 27 MHz Clock Option.

3.1.6. RS-232 Interface

This operation mode uses the standard factory jumper settings illustrated in Figure 1 on page 3. The Maxim MAX3237 transceiver interfaces directly with the TTL levels available at the serial interface of the Si2400 and, using internal charge pumps, makes these signals compatible with the RS-232 standard. The RS-232 transceiver on the Si2400USB-EVB can communicate at rates between 300 bps and 1 Mbps. This simplifies the connection to PCs and other Data Terminal Equipment (DTE). The signals available on the Si2400USB-EVB serial interface (DB9 connector) are listed in Table 4.

Table 4. DB9 Pin Connections

J1 Name	J1 Symbol	J1 Pin	Si2400 Pin	Si2400 Name
Carrier Detect	CD	1^1		
Received Data	RXD	2	5	RXD
Transmit Data	TXD	3	6	TXD
Data Terminal Ready	DTR	4^2	14	ESC/GPIO3
Signal Ground	SG	5	12	GND
Data Set Ready	DSR	6	Note [3]	
Ready to Send	RTS	7	nc	
Clear to Send	CTS	8	7	$\overline{\text{CTS}}$
Ring Indicator	RD	9^1	nc	

Notes:
1. JP6 + JP5 jumper option.
2. JP6 Jumper option.
3. DSR connected to DTR at J1.

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3.1.7. USB Interface

The USB cable connects to J5 on the motherboard and provides both data and power. Installing a jumper on JP5 enables the USB interface and disables the RS-232 interface. The USB interface is provided by U5. A USB driver for this chip is available for most PC and MAC operating systems on the CD.

3.1.8. Direct Access Interface

The motherboard supplies power through J3, J4, or USB, power-on reset, and an RJ-11 jack for the modem. The direct access interface, JP3, is used to connect the motherboard to an embedded system. JP3 provides access to all Si2400 signals available on the daughter card. It is necessary to install a jumper on JP8 to disable both the RS-232 and USB interface and prevent signal contention. *Leave the jumper between JP7 pins 1 and 2.* Figure 3 illustrates the jumper settings required for the direct access mode using the motherboard.
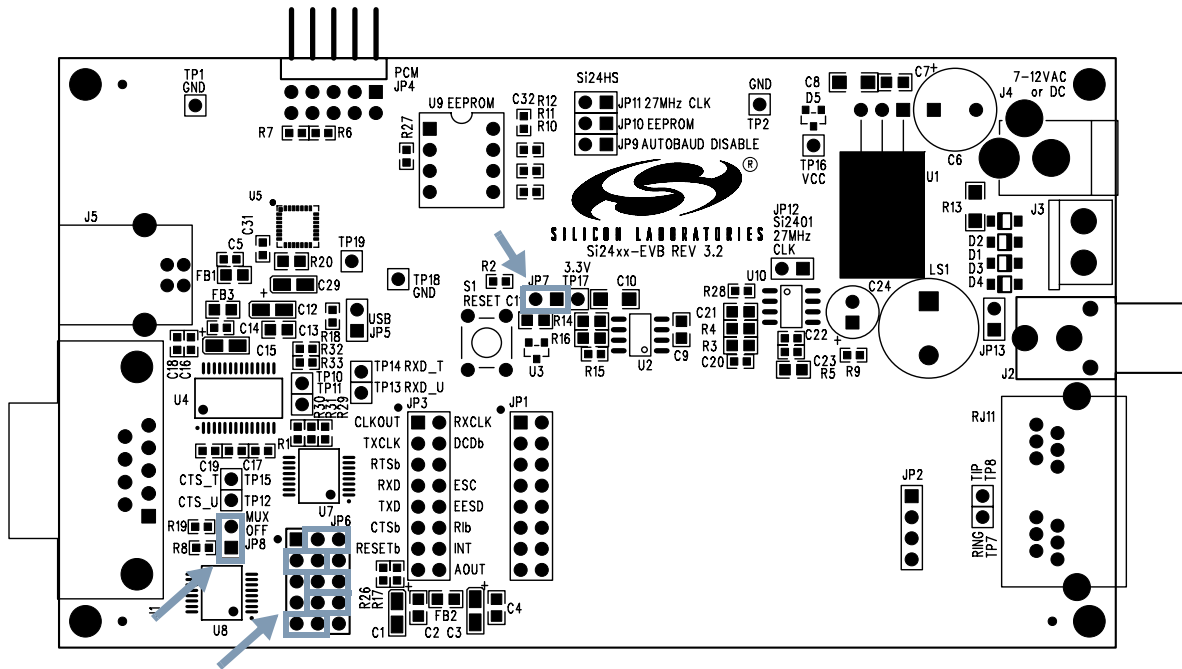

Figure 3. Jumper Settings for Direct Access Interface

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3.1.9. Audio Output

Audio output is provided from the Si2400 on the pin, AOUT. This signal allows the user to monitor call progress signals, such as dial tone, DTMF dialing, ring, busy signals, and modem negotiation. Control of this signal is provided by AT commands and register settings described in the introduction. The AOUT signal can be connected to an amplifier, such as the LM386 (the default stuffing option on the Si2400URT-EVB), for high-quality output. AOUT can also be connected to a summing amplifier or multiplexer in an embedded application as part of an integrated audio system.

3.1.10. Amplifier (LM386)

The audio amplifier circuit consists of U10 (LM386), C20, R3, R4, C21, C22, C23, R5, C24, and an optional loudspeaker, LS1. The LM386 has an internally-set voltage gain of 20. R3 and R4 provide a voltage divider to reduce the AOUT signal to prevent overdriving the LM386. C20 provides dc blocking for the input signal and forms a high-pass filter with R3+R4, while R4 and C21 form a low-pass filter. These four components limit the bandwidth of the AOUT signal. C22 provides high-frequency power supply bypassing for the LM386 and should be connected to a hard ground and located very close to the amplifier's power supply and ground pins. C23 and R5 form a compensation circuit to prevent oscillation of the high current pnp transistor in the LM386 output stage on negative signal peaks. These oscillations can occur between 2–5 MHz and can pose a radiation compliance problem if C23 and R5 are omitted. C24 provides dc blocking for the output of the LM386, which is biased at approximately 2.5 V ($V_{CC}/2$), and forms a high-pass filter with the impedance of the loudspeaker (LS1). The output from the LM386 amplifier circuit is available on the RCA jack, J2 (not installed). Install jumper JP13 to enable the onboard speaker, LS1.

3.2. Modem Module Operation

The Si2400URT-EVB daughter card is a complete modem solution perfectly suited for use in an embedded system. The daughter card requires a 3.3 V supply capable of providing at least 35 mA and communicates with the system via LVCMOS/TTL-compatible digital signals on JP1. The RJ-11 jack (TIP and RING) is connected via JP2. Be sure to provide the proper power-on reset pulse to the daughter card if it is used in the stand-alone mode.

3.2.1. Reset Requirements

The Si2400 ISOmodem daughter card must be properly reset at powerup. The reset pin (pin 8) of the Si2400, (JP1, pin 13), must be held low for at least 5.0 ms after power is applied and stabilized and returned high with a rise time less than 100 ns to ensure the device is properly reset.

3.2.2. Crystal Requirements

Clock accuracy and stability are important in modem applications. To ensure reliable communication between modems, the clock must remain within ±100 ppm of the design value over the life of the modem. The crystal selected for use in a modem application must have a frequency tolerance of less than ±100 ppm for the combination of initial frequency tolerance, drift over the normal operating temperature range, and five-year aging. Other considerations, such as production variations in PC board capacitance and the tolerance of loading capacitors, must also be taken into account.

3.2.3. Protection

The Si2400URT-EVB meets or exceeds all FCC and international PTT requirements and recommendations for high-voltage surge and isolation testing without any modification. The protection/isolation circuitry includes C1, C2, C8, C9, FB1, FB2, and RV1. The PCB layout is also a key "component" in the protection circuitry. The Si2400URT-EVB provides isolation to 3 kV. Contact Silicon Laboratories for information about designing to higher levels of isolation.

4. Design

The following pages contain the schematics, bill of materials, and layout for the Si2400, including the daughter card and motherboard.
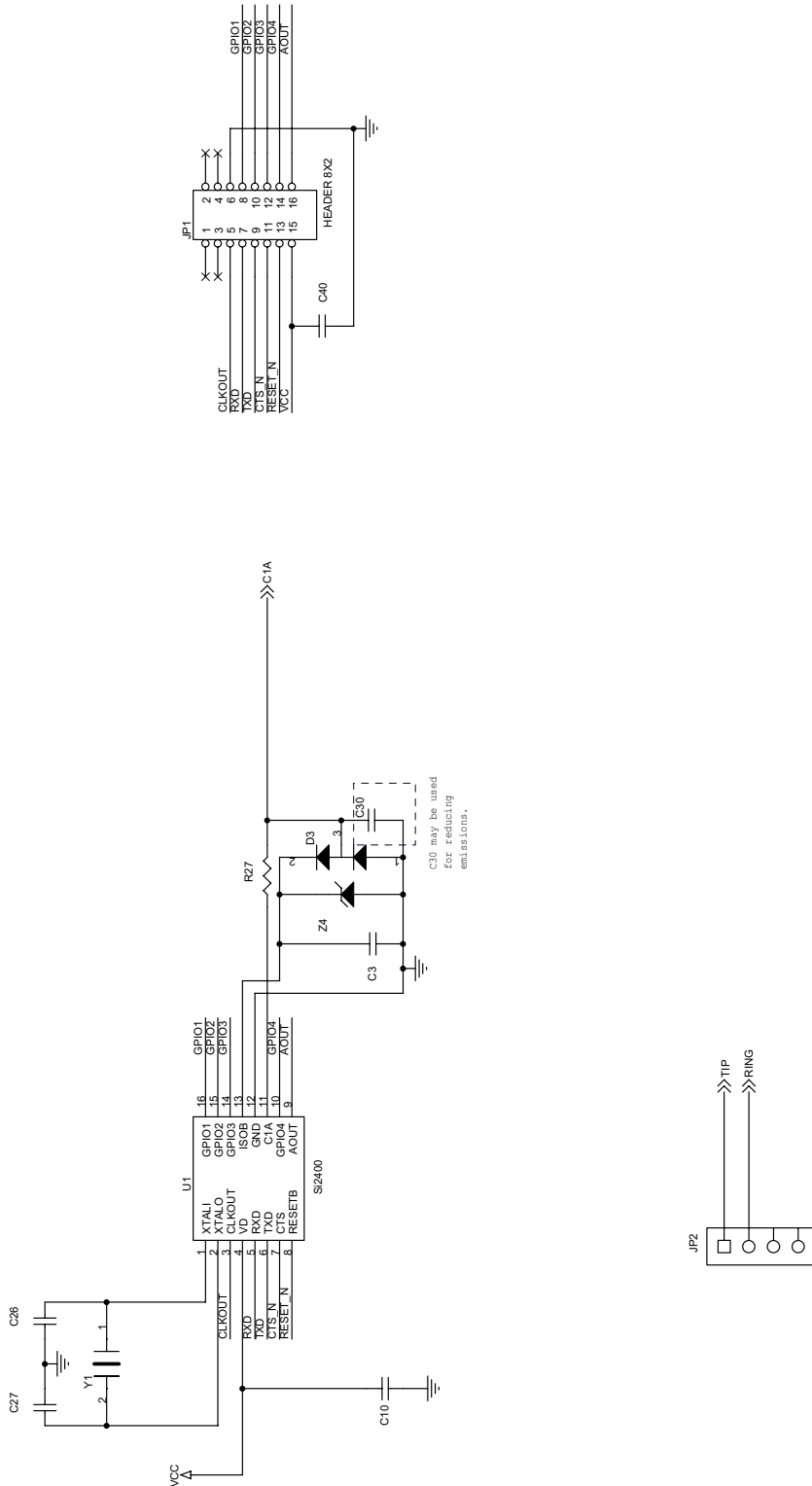
Figure 4. Si2400 Schematic

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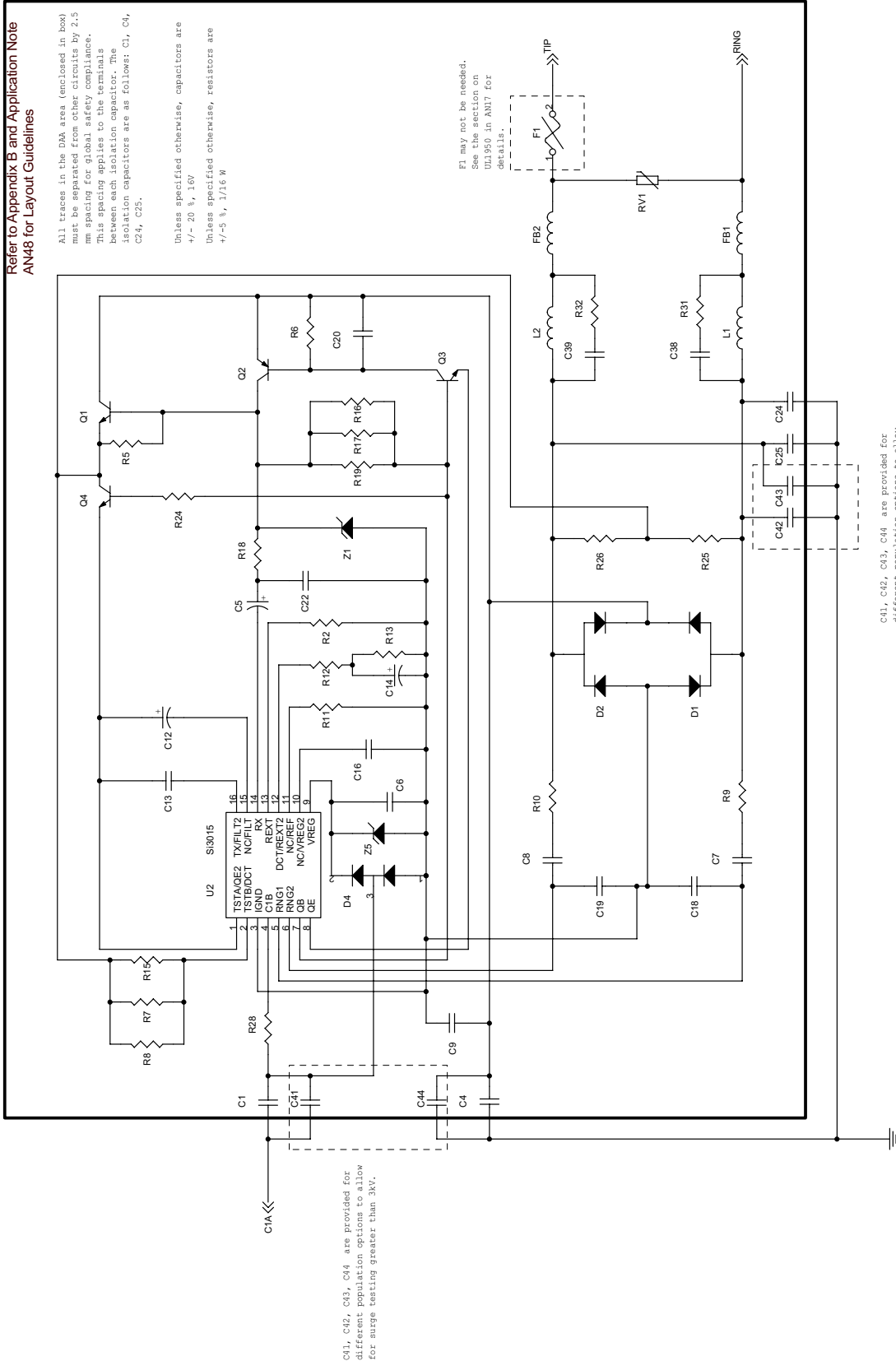
Figure 5. Si3015 DAA Schematic

Refer to Appendix B and Application Note AN48 for Layout Guidelines

All traces in the DAA area (enclosed in box) must be separated from other circuits by 2.5 mm spacing for global safety compliance. This spacing applies to the terminals between each isolation capacitor. The isolation capacitors are as follows: C1, C4, C24, C25.

Unless specified otherwise, capacitors are +/- 20 %, 16V

Unless specified otherwise, resistors are +/-5 %, 1/16 W

F1 may not be needed. See the section on UL1950 in AN17 for details.

C41, C42, C43, C44 are provided for different population options to allow for surge testing greater than 3kV.
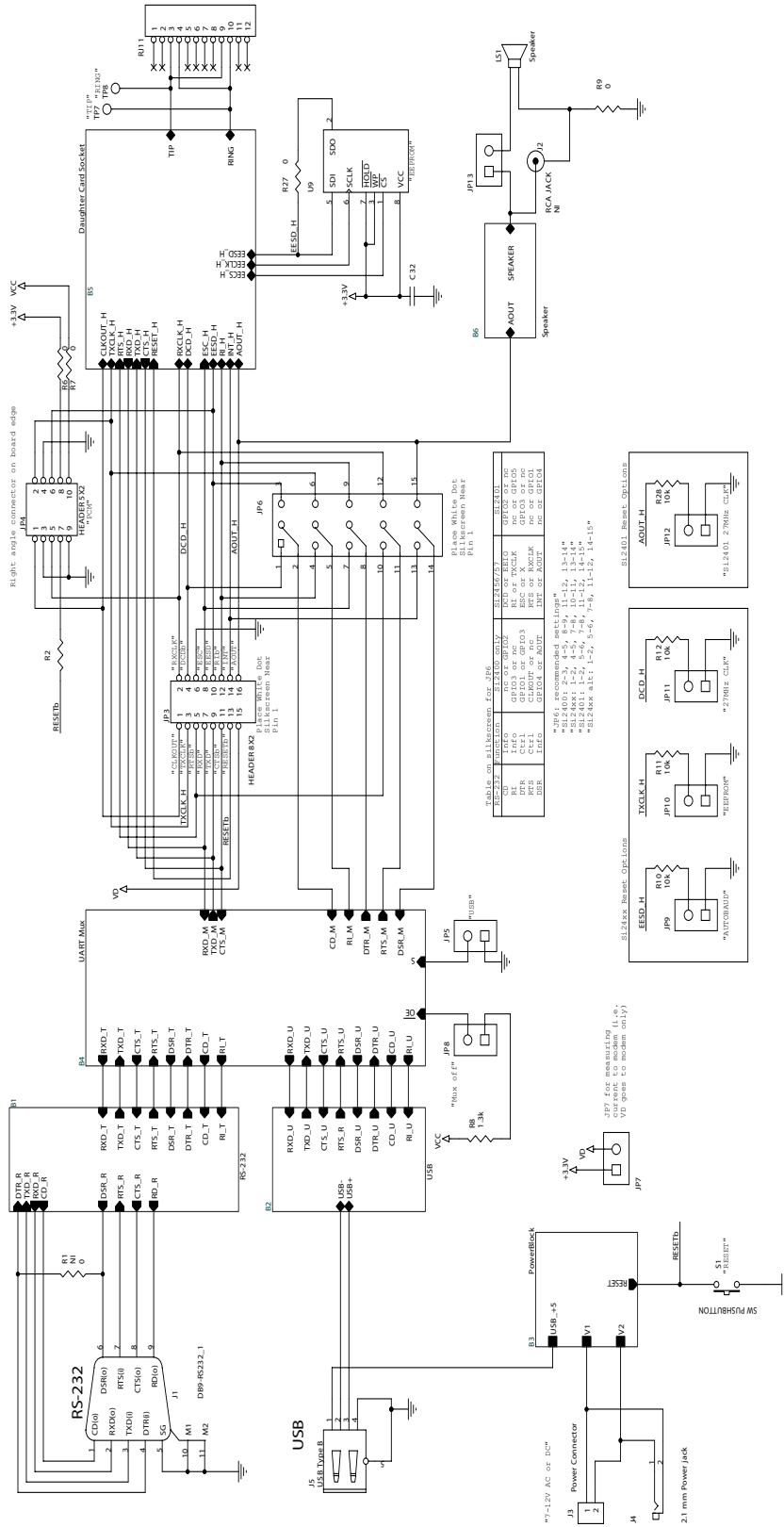
C41, C42, C43, C44 are provided for different population options to allow for surge testing greater than 3kV.

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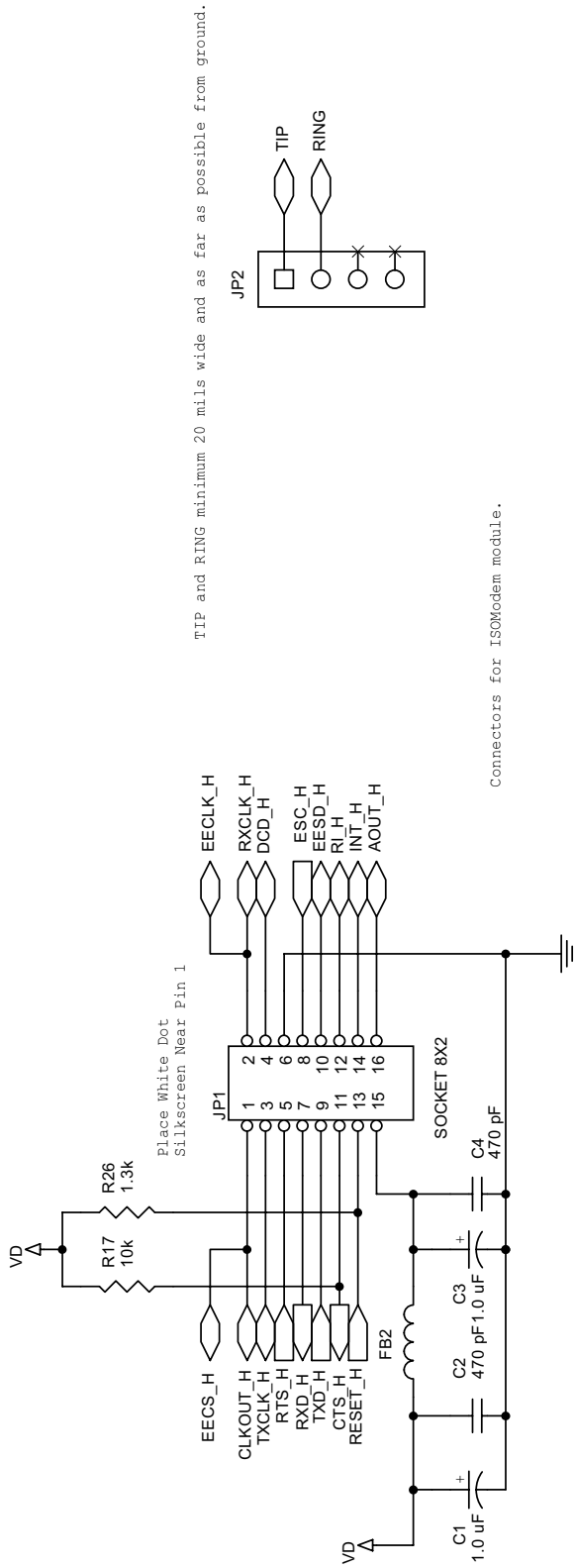**Table 5. Si2400 Daughter Card Bill of Materials**

Component	Value	Supplier*
C1,C4	150 pF, 3 kV, X7R, ±10%	Novacap
C3,C13	0.22 µF, 25 V, X7R, ±20%	Venkel
C5	0.1 µF, 50 V, Tant, ±20%	Venkel
C6,C10,C16	0.1 µF, 16 V, X7R, ±20%	Venkel
C7,C8	560 pF, 250 V, X7R, ±10%	Venkel
C9	22 nF, 250 V, X7R, ±10%	Venkel
C12	1.0 µF, 35 V, Tant, ±10%	Venkel
C14	0.68 µF, 16 V, Tant, ±10%	AVX
C18,C19	3.9 nF, 16 V, X7R, ±10%	Venkel
C20	0.01 µF, 16 V, X7R, ±10%	Venkel
C22	1800 pF, 50 V, X7R, ±10%	Venkel
C24,C25	1000 pF, 3 kV, X7R, ±10%	Novacap
C26,C27	33 pF, 16 V, NPO, ±5%	Venkel
C38,C39	47 pF, 16 V, X7R, ±10%	Venkel
D1,D2	Dual Diode, 225 mA, 300 V	Central Semiconductor
D3,D4	BAV99, 300 mA, 100 V	Diodes, Inc.
FB1,FB2	Ferrite Bead	Murata
F1	Fuse	Teccor
JP1	HEADER 8x2	Samtec
JP2	4x1 Header_0	Berg
L1,L2	68 µH, 150 mA, 4 Ω max, ±10%	Murata
Q1,Q3	NPN, 300 V	Motorola
Q2	PNP, 300 V	Motorola
Q4	NPN, 80 V	Motorola
RV1	SiDactor, 275 V, 100 A	Teccor
R2	402 Ω, 1/16 W, ±1%	Venkel
R5	100 kΩ, 1/16 W, ±1%	Venkel
R6	120 kΩ, 1/16 W, ±5%	Venkel
R7,R8,R15–17, R19	5.36 kΩ, 1/4 W, ±1%	Venkel
R9,R10	56 kΩ, 1/10 W, ±5%	Venkel
R11	9.31 kΩ, 1/16 W, ±1%	Venkel
R12	78.7 Ω, 1/16 W, ±1%	Venkel
R13	215 Ω, 1/16 W, ±1%	Venkel
R18	2.2 kΩ, 1/10 W, ±1%	Venkel
R24	150 Ω, 1/10 W, ±5%	Venkel
R25,R26	10 MΩ, 1/10 W, ±5%	Venkel
R27,R28	10 Ω, 1/16 W, ±5%	Venkel
R31,R32	470 Ω, 1/16 W, ±5%	Venkel
U1	Si2400	Silicon Labs
U2	Si3015	Silicon Labs
Y1	4.9152 MHz, 20 pF load, 150 ESR, 50 ppm	CTS Reeves
Z1	Zener, 43 V, 300 mW	General Semi
Z4,Z5	Zener, 5.6 V, 500 mW	Diodes, Inc.
*Note: Many other suppliers are available. See the Si2400 data sheet.		

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Figure 6. Motherboard Top-Level Schematic

Figure 7. Daughter Card Interface Schematic

TIP and RING minimum 20 mils wide and as far as possible from ground.

Connectors for ISOModem module.

Net names correspond to Si24xx. See table for Si2400 equivalents

Table NOT on silkscreen

JP1/3	Si2400	Si24xx	Si2401
1	NC	CLKOUT/A0/EECS	NC
2	NC	EECLK/D5/RXCLK	GPIO1
3	NC	alt_RIb/TXCLK/D6	GPIO5
4	NC	DCD/D4	GPIO2
5	CLKOUT	RTS/D7	NC
6	GND	GND	GND
7	TXD	TXD/WR	TXD
8	GPIO1	ESC/D3	GPIO3
9	RXD	RXD/RD	RXD
10	GPIO2	EESD/D2	NC
11	CTS	CTS/CS	CTS
12	GPIO3	RI/D1	NC
13	RESET	RESET	RESET
14	GPIO4	INT/D0	NC
15	VD	VD	VD
16	AOUT	AOUT/INT	GPIO4

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Figure 8. Power Supply Schematic

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Figure 9. RS-232 Interface Schematic
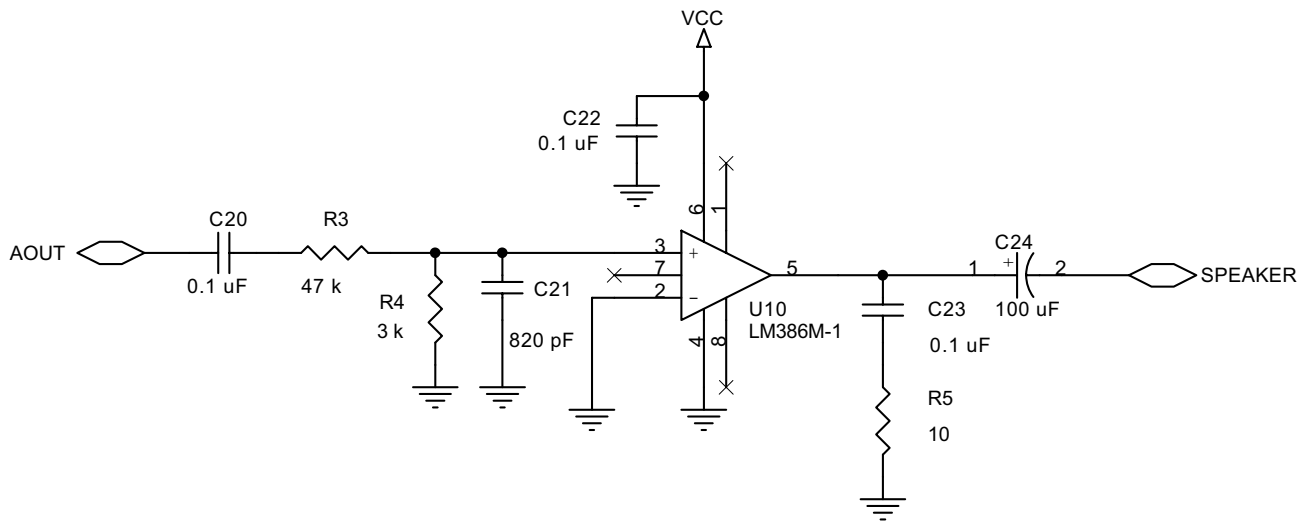
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Figure 10. Audio Amplifier Schematic
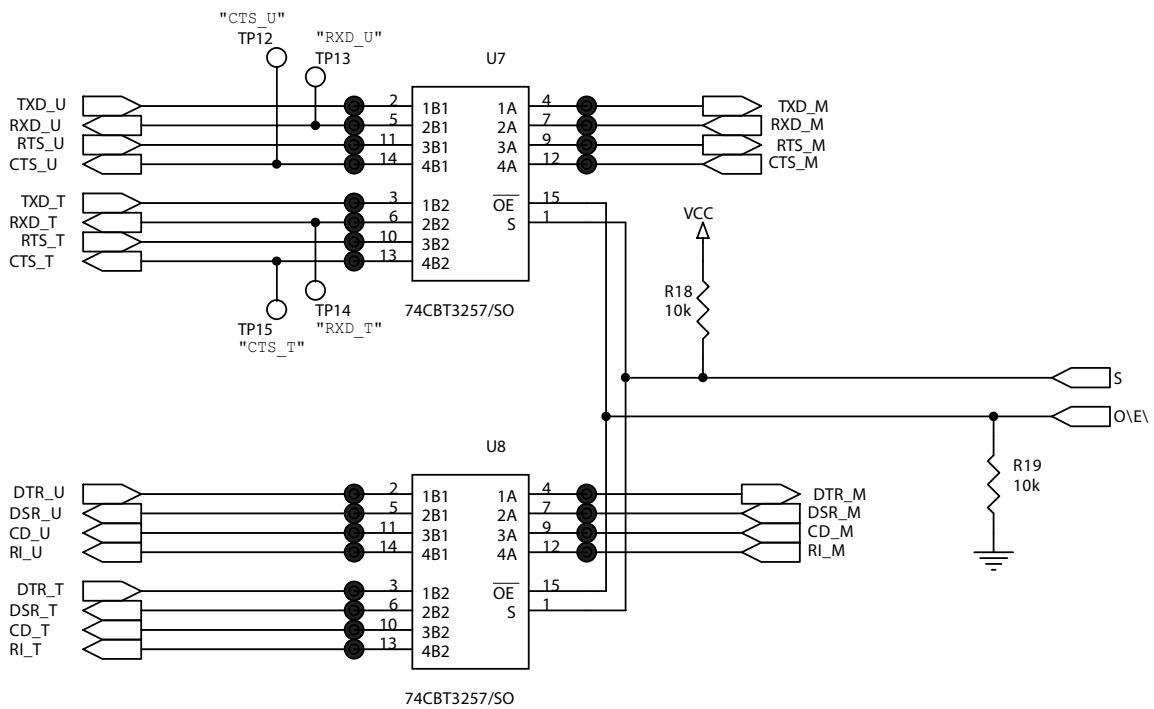
Figure 11. UART MUX Schematic

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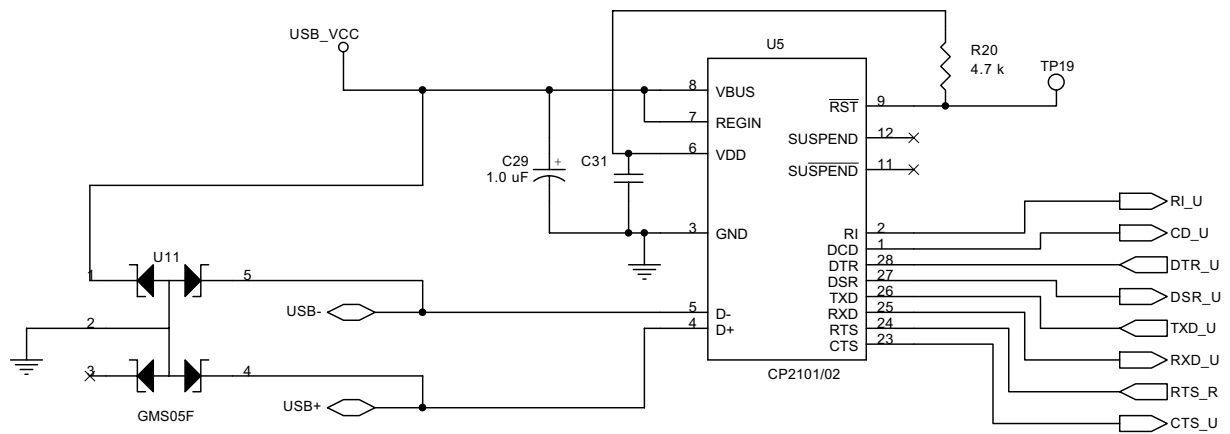
Figure 12. USB Interface Schematic

Si2400URT-EVB

5. Si24xx Motherboard Bill of Materials

Item	Quantity	Reference	Value	Rating	Tolerance	Foot Print	Dielectric	Manufacturer Number	Manufacturer
1	5	C1,C3,C12,C15,C29	1.0 uF	10 V	±10%	3216_EIAA	Tant	TA010TCM105-KAL	Venkel
2	4	C2,C4,C11,C13	470 pF	25V	±5%	CC0805	X7R	C0805C471J5GACTU	TTI
3	1	C5	10 nF	16 V	±10%	CC0603	X7R	C0603X7R160-103KNE	Venkel
4	1	C6	470 uF	25 V	±20%	C5X10MM-RAD	Electrolytic	UVX1E471MPA	NIC Components
5	2	C7,C9	0.1 uF	25 V	±10%	CC0805	X7R	C0805X7R250-104KNE	Venkel
6	2	C10,C8	10 uF	16V	±10%	CC1206	X7R	C1206X7R100-106KNE	Venkel
7	10	C14,C16,C17,C18,C19,C20,C22,C23,C31,C32	0.1 uF	16 V	±20%	CC0603	X7R	C0603X7R160-104MNE	Venkel
8	1	C21	820 pF	50 V	±5%	CC0805	NPO	C0805COG500-821JNE	Venkel
9	1	C24	100 uF	16 V	±10%	C2.5X6.3MM-RAD	Electrolytic	UVX1C101MEA1TD	Nichicon
10	4	D1,D2,D3,D4	DIODE	30 V	0.5 A	SOD123		MBR0530T1	Motorola
11	1	D5	BAT54C			SOT-23		BAT54C	Diodes Inc.
12	8	D6,D7,D8,D9,D10,D11,D12,D13	MMBZ15VDC			SOT-23		MMBZ15VDC	General Semiconductor
13	3	FB1,FB2,FB3	Ferrite Bead			RC0805		BLM21A601S	Murata
14	1	JP1	SOCKET 8X2			CONN2X8		SSW-108-01-T-D	Samtec
15	1	JP2	4X1 Socket			CONN4[6238]		SSW-104-01-T-S	Samtec
16	1	JP3	HEADER 8X2			CONN2X8		517-6121TN	Samtec
17	1	JP4	HEADER 5X2			CONN2X5[6238]RA		TSW-105-25-T-D-RA	Samtec
18	8	JP5,JP7,JP8,JP9,JP10,JP11,JP12,JP13	2X1 Header			CONN2[6040]		517-611TN	Berg
19	1	JP6	3x5 Header			CONN3X5			
20	1	J1	DB9-RS232_1			CONN9[6543]DBF		K22-E9S-030	Kycon
21	1	J2	RCA JACK			CONN2[12090]RCA		16PJ097	Mouser
22	1	J3	Power Connector			TB2[12065]TSA		506-5ULD02	Mouser
23	1	J4	2.1 mm Power jack			CONN3[175120]PWR		ADC-002-1	Adam Tech
24	1	J5	USB Type B			CONN-USB-B		897-30-004-90-000000	Mill-Max
25	1	LS1	Speaker			HCM12A[9052]		HCM1206A	JL World
26	1	RJ11	MTJG-2-64-2-2-1			RJ11[6238]DUAL		MTJG-2-64-2-2-1	Adam Tech
27	6	R2,R6,R7,R9,R15,R27	0	1/10 W		RC0603		CR0603-10W-000JT	Venkel
28	1	R3	47 k	1/10 W	±5%	RC0805		NRC10J473TR	NIC Components
29	1	R4	3 k	1/10 W	±5%	RC0805		NRC10J302TR	NIC Components
30	1	R5	10	1/10 W	±1%	RC0805		NRC10F10R0TR	NIC Components
31	2	R26,R8	1.3k	1/16 W	±5%	RC0603		CR0603-16W-132JT	Venkel
32	10	R10,R11,R12,R17,R18,R19,R28,R29,R30,R33	10k	1/16 W	±5%	RC0603		CR0603-16W-103JT	Venkel
33	1	R13	1.6	1/8 W	-0.05	RC1206		CR1206-8W-1R6JT	Venkel
34	1	R14	196k			RC0805		MCHRIDEZHFX1963E	Classic Comp
35	1	R16	110k			RC0805		CR21-114J-T	Classic Comp
36	1	R20	4.7 k	1/10 W	±5%	RC0805		NRC10J472TR	NIC Components
37	1	S1	SW PUSHBUTTON			SW4[6240]PB		101-0161	Mouser
38	3	TP1,TP2,TP18	Black Test Point			CONN1[6040]		151-203	Mouser
39	4	TP3,TP4,TP5,TP6	Stand off			MH-125			
40	8	TP7,TP8,TP10,TP11,TP12,TP13,TP14,TP15	Blue Test Point			CONN1[6040]		151-205	Mouser
41	2	TP16,TP17	Red Test Point			CONN1[6040]		151-207	Mouser
42	1	TP19	Blue Test Point			CONN1[6040]		151-207	Mouser
43	1	U1	7805			TO-220-LD		uA7805CKC	Texas Instruments
44	1	U2	TPS77601DR			SO8		TPS77601DR	Texas Instruments
45	1	U3	DS1818			SOT-23		DS1818-10	Dallas Semiconductor
46	1	U4	MAX3237			SOP65X780-28N		MAX3237E (Sipex SP3238E 2nd source)	Maxim
47	1	U5	CP2101/02			28-pin MLP		CP2101/02	Silicon Laboratories
48	2	U8,U7	74CBT3257/SO			SOP65X780-16N		SN74CBT3257DBR	Texas Instruments
49	1	U9	PDIP Socket			DIP8-SKT		210-93-308-41-001000	Mill-Max
50	1	U10	OP-AMP			SO8		LM386M-1	National Semi
51	1	U11	GMS05F			SOT-23-5N		GMS05F	Vishay

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6. PCB Layers
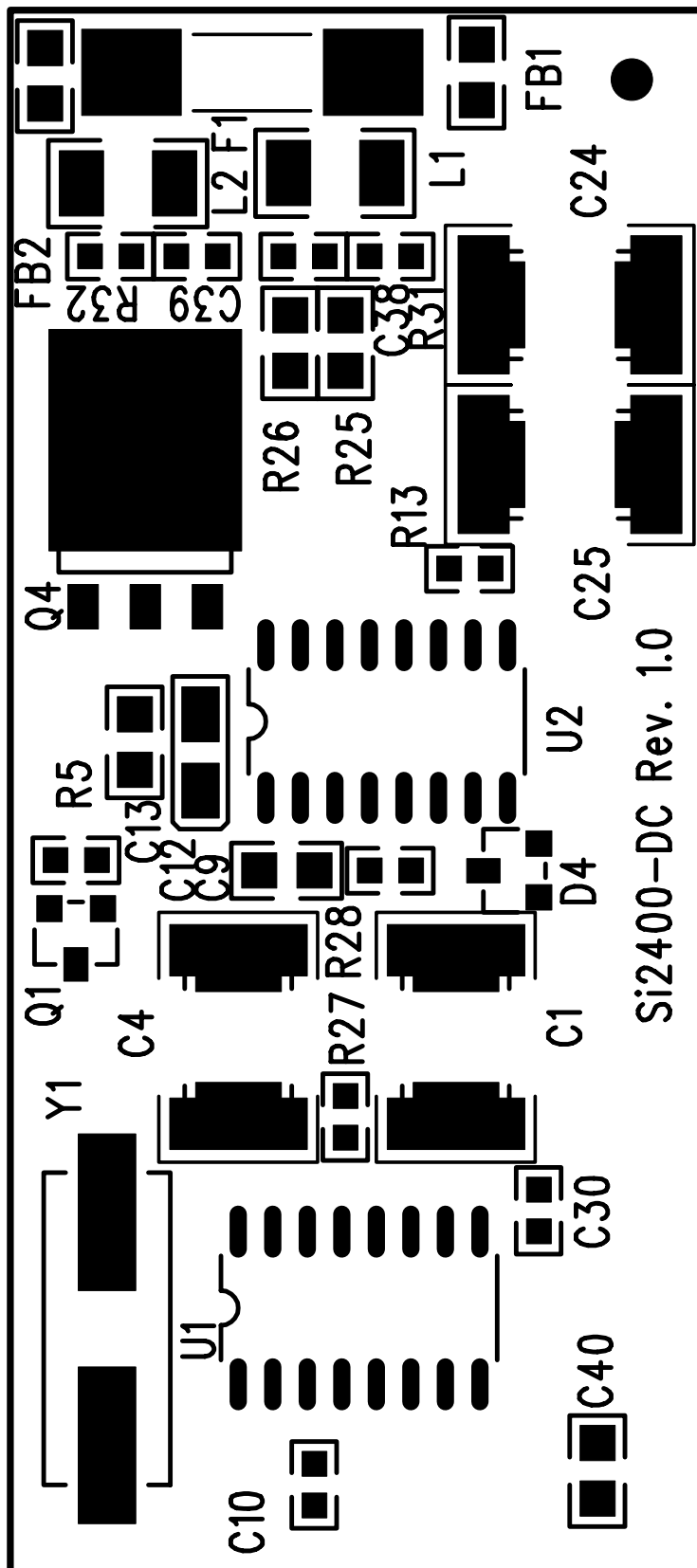
Figure 13. Daughter Card Component Side Silkscreen
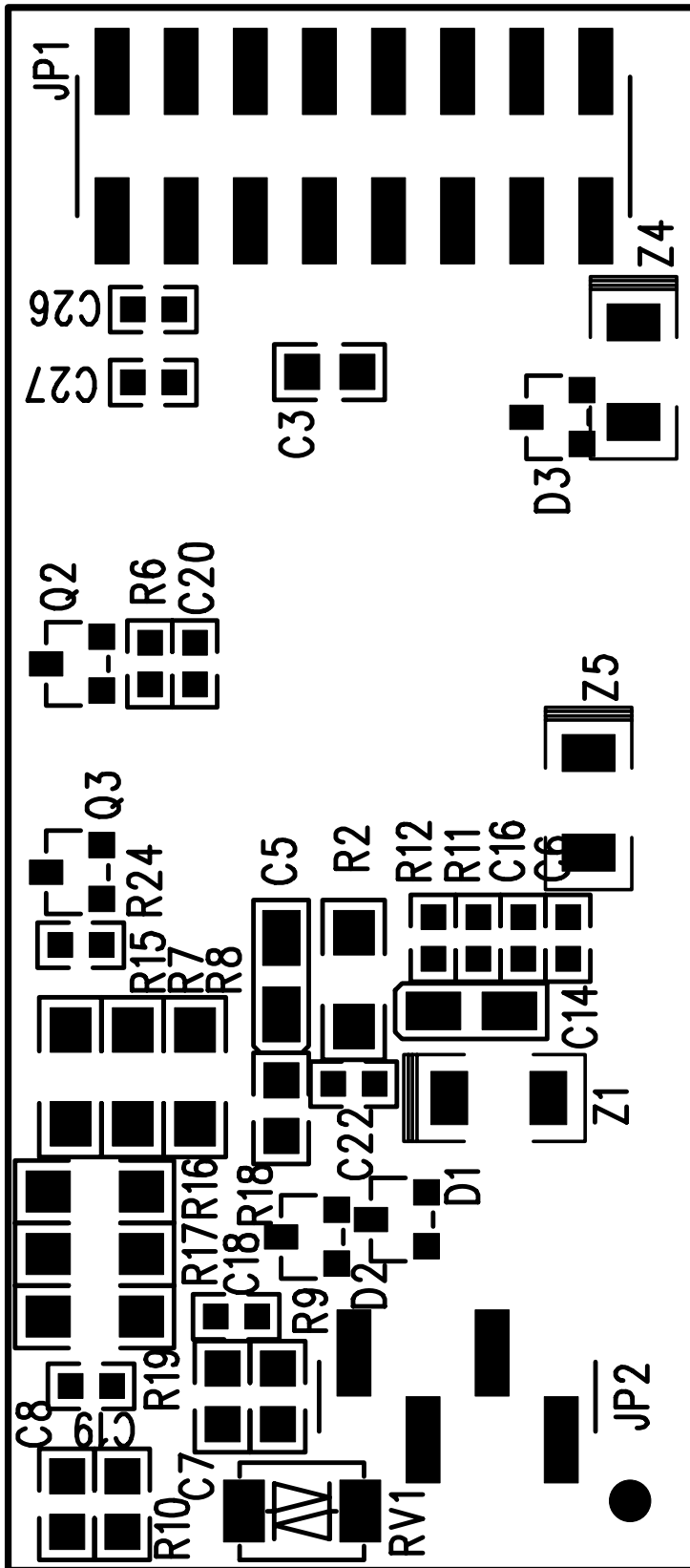
Figure 14. Daughter Card Solder Side Silkscreen

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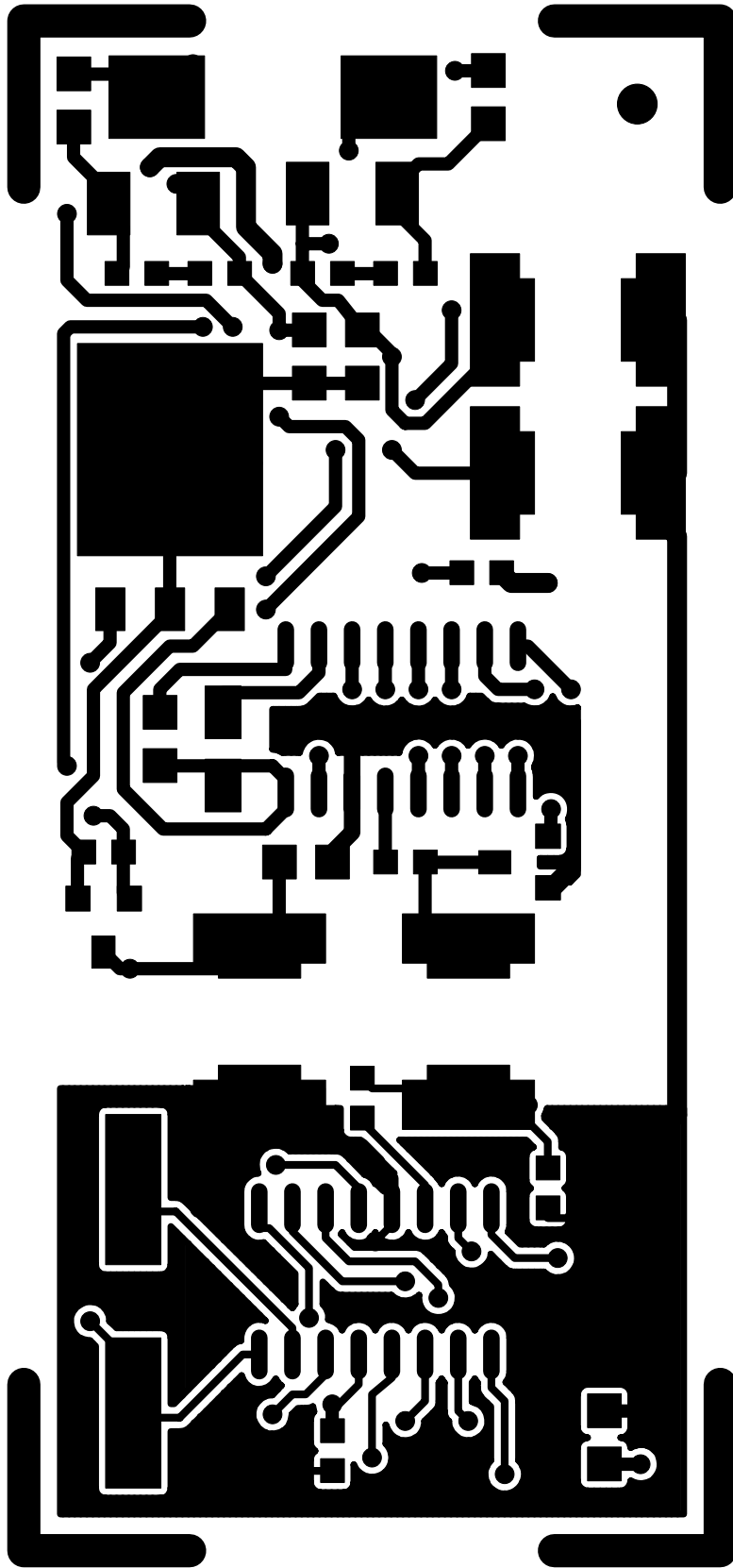
Figure 15. Daughter Card Component Side Layout

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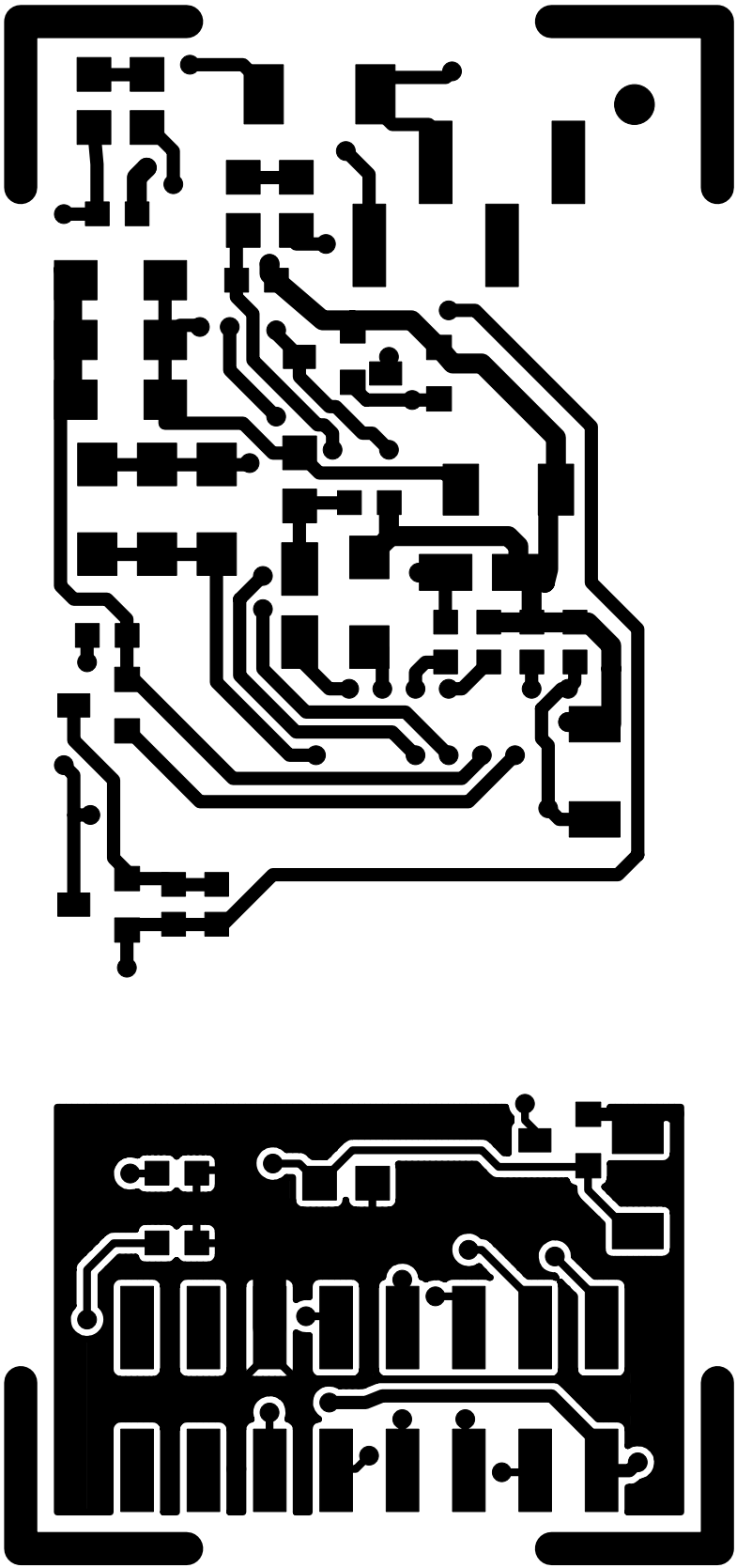
Figure 16. Daughter Card Solder Side Layout

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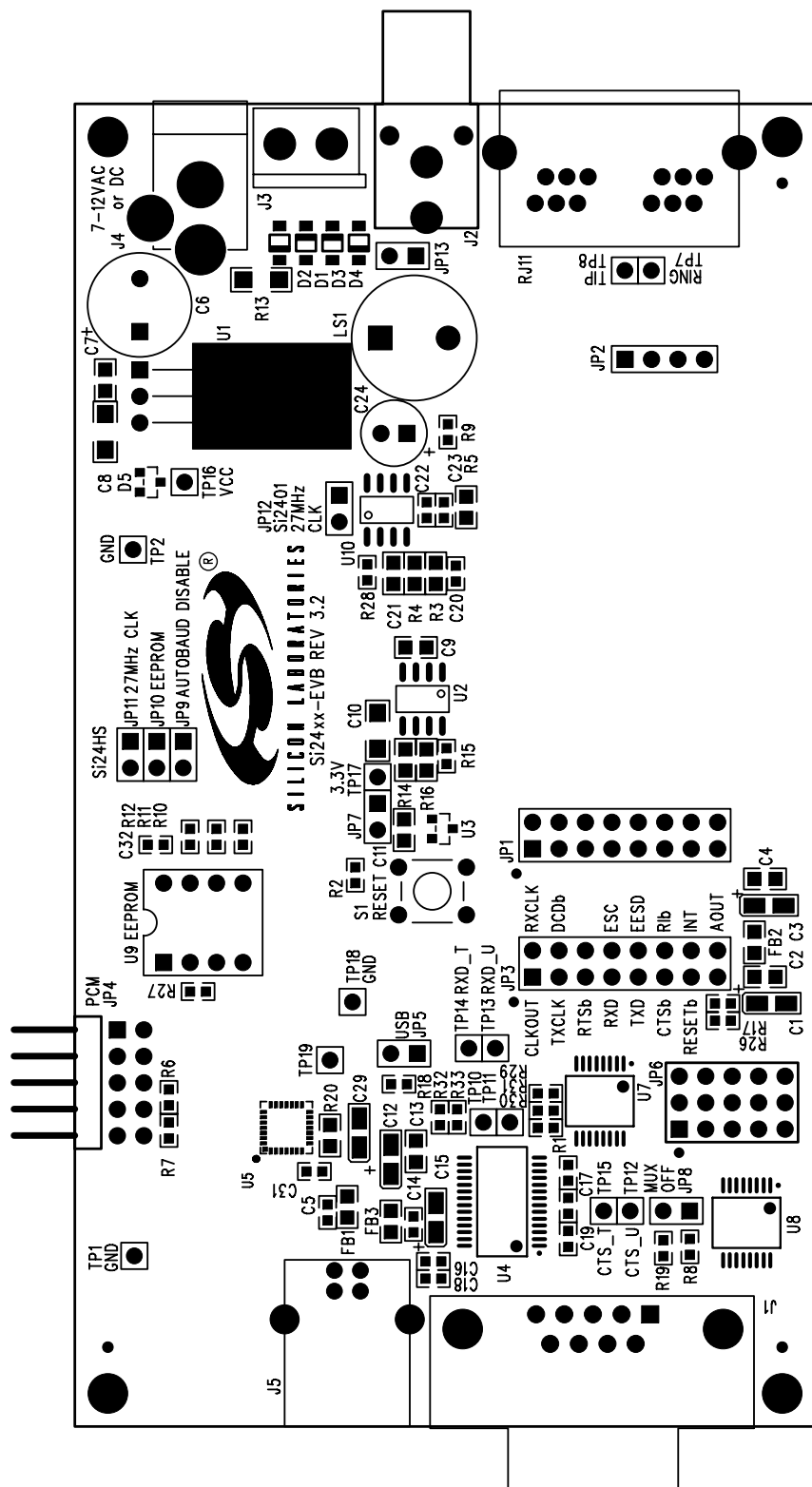
Figure 17. Motherboard Silkscreen (Front Side)

Si2401	Si24HS	Si2400	Function	RS–232
GPIO2 or NC	DCD or EESD	NC or GPIO2	Info	CD
NC or GPIO5	RI or TXCLK	GPIO3 or NC	Info	RI
GPIO3 or NC	ESC or X	GPIO1 or GPIO3	Ctrl	DTR
NC or GPIO1	RTS or RXCLK	CLKOUT or NC	Ctrl	RTS
NC or GPIO4	INT or AOUT	GPIO4 or AOUT	Info	DSR

JP6 recommended settings
Si2400: 2–3, 4–5, 8–9, 11–12, 13–14
Si24HS: 1–2, 4–5, 7–8, 10–11, 13–14
Si2401: 1–2, 5–6, 7–8, 11–12, 14–15
Si24HS alt: 1–2, 5–6, 7–8, 11–12, 14–15

U11

D11 D13 D6 D8

D9 D7 D12 D10

Figure 18. Motherboard Silkscreen (Back Side)

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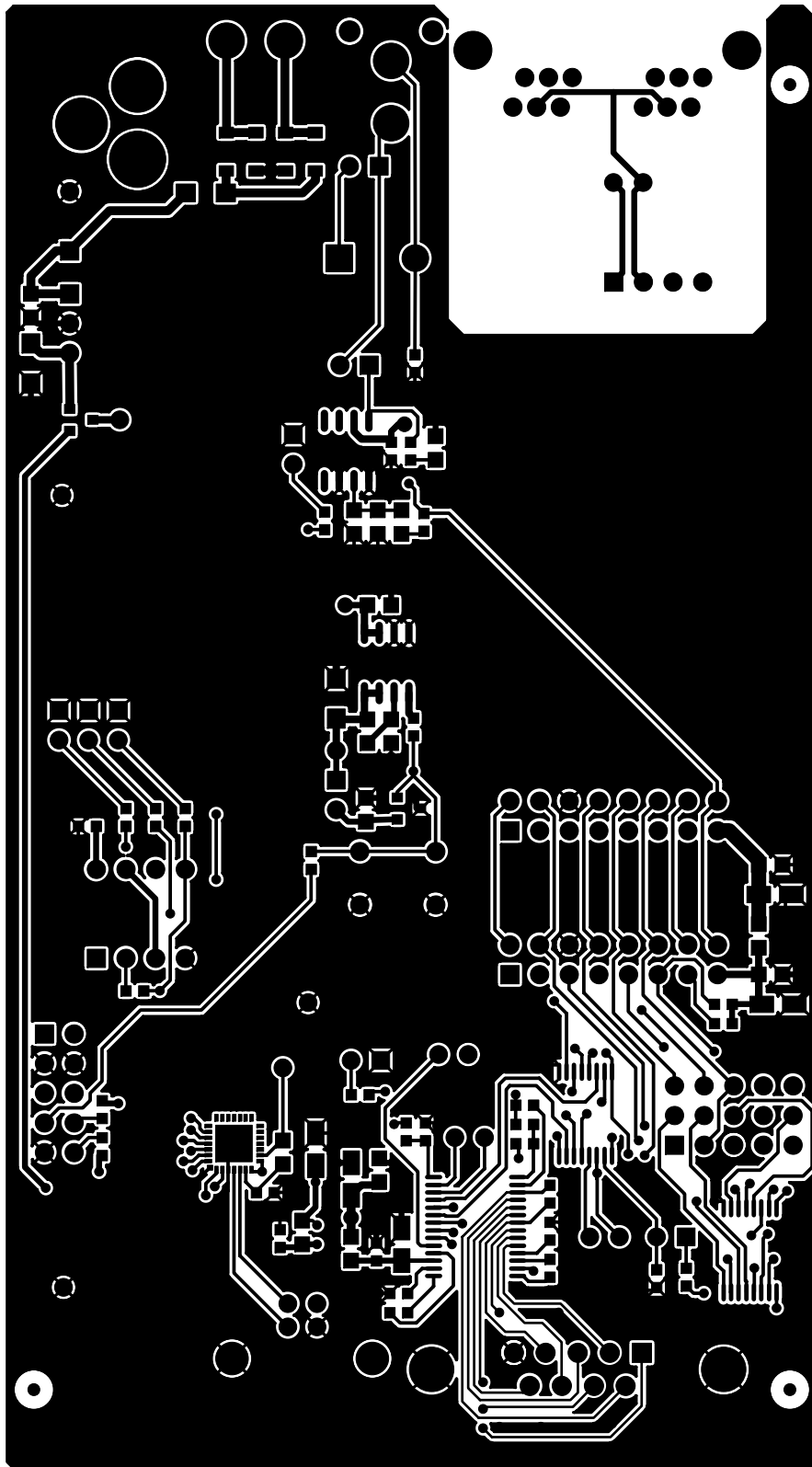
Figure 19. Motherboard Component Side Layout

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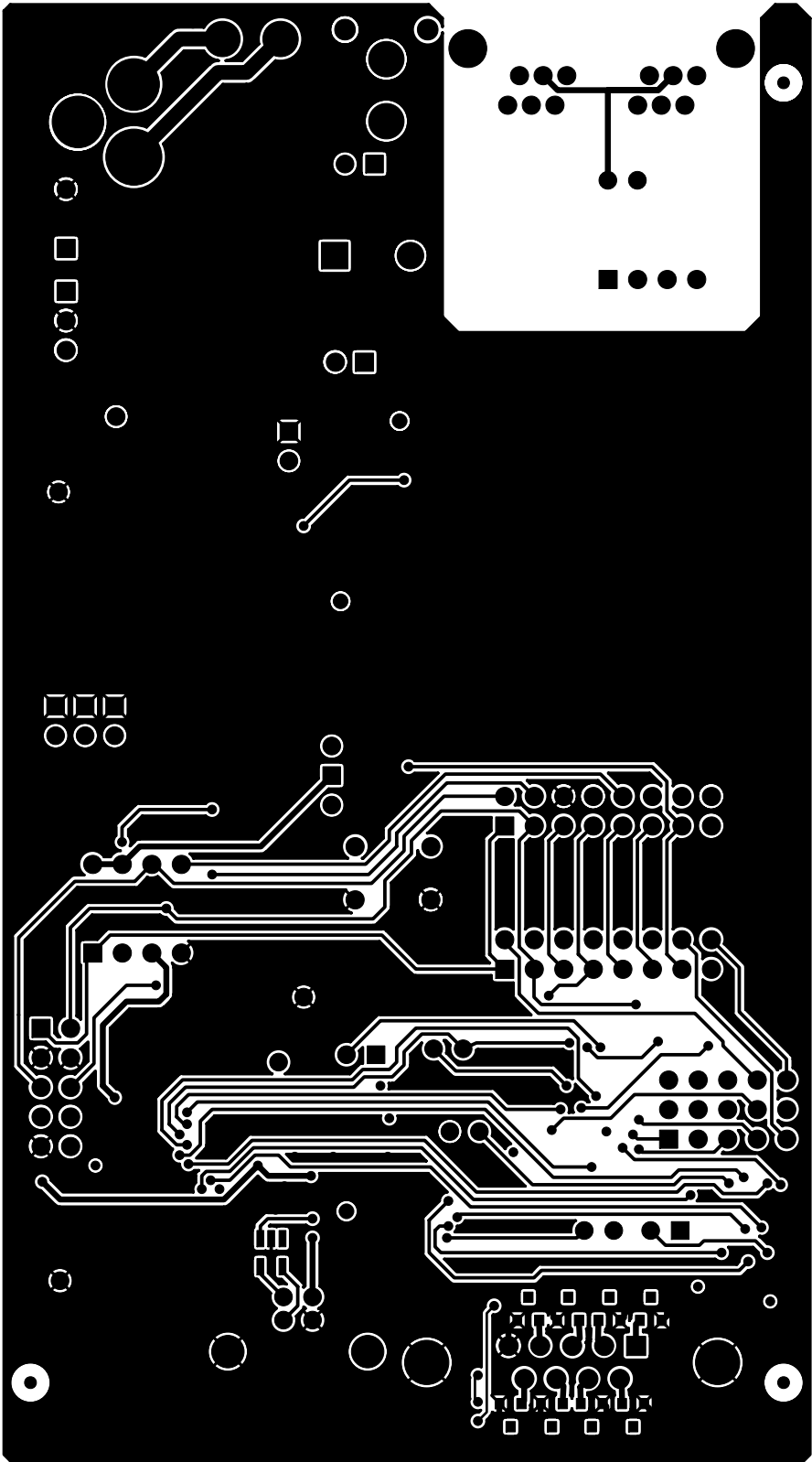
Figure 20. Motherboard Solder Side Layout

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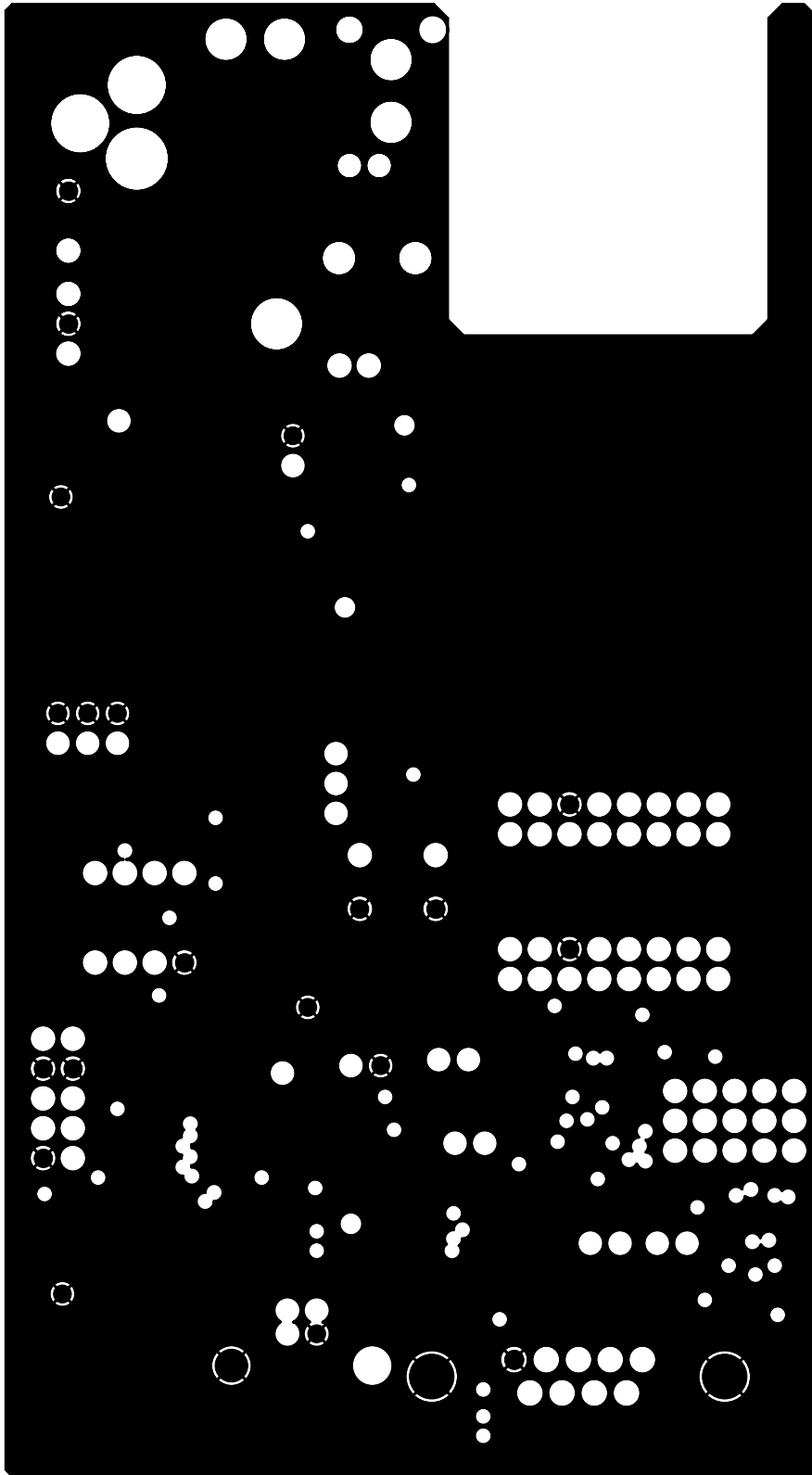
Figure 21. Motherboard Ground Plane Layout

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Figure 22. Motherboard Power Plane Layout

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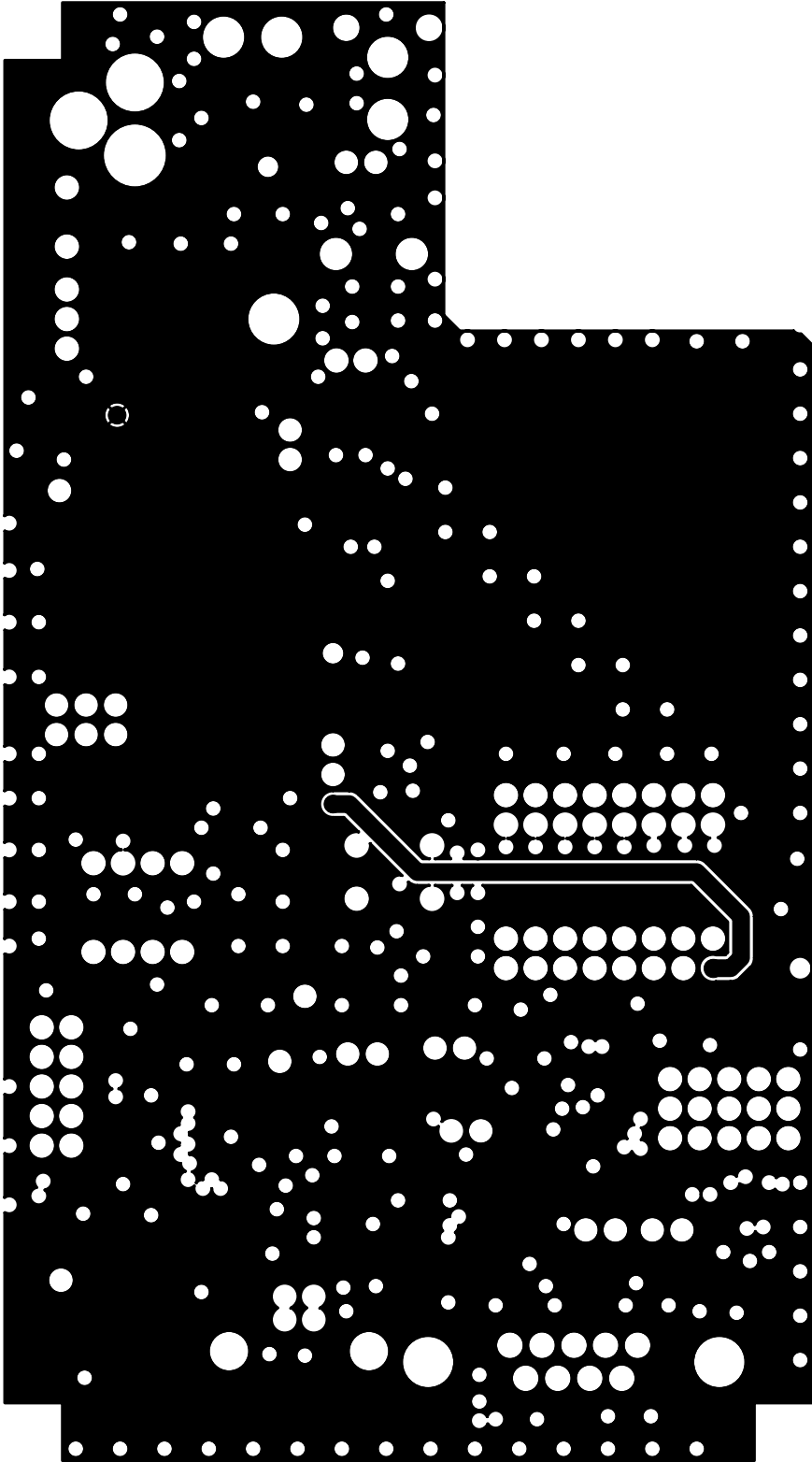
7. Complete Design Package on CD (See Sales Representative for Details)

Silicon Laboratories can provide a complete design package of the Si2400URT-EVB including the following:

- OrCad Schematics
- Gerber Files
- BOM
- Documentation

Contact your local sales representative or Silicon Laboratories headquarter sales for ordering information.

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DOCUMENT CHANGE LIST

Revision 0.6 to Revision 0.7

- Updated from Rev 1.0 motherboard to Rev 3.2 motherboard.
- Updated the following figures and tables:
  - Figures 1,3,5,6,7,8,9,10,11, and 12
  - Table 6
- Added the following figures:
  - Figures 2,19,20,21,22,23,24
- Updated "2. Si2400URT-EVB Setup and Evaluation," on page 2.

NOTES:

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Si2400URT-EVB

CONTACT INFORMATION

Silicon Laboratories Inc.

4635 Boston Lane
Austin, TX 78735
Tel: 1+(512) 416-8500
Fax: 1+(512) 416-9669
Toll Free: 1+(877) 444-3032

Email: SiDAAinfo@silabs.com
Internet: www.silabs.com

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